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Environment Ontario

# legacy

July 1982

Vol. 11, No. 1







*People, working with you . . .*

# The challenges of the 80s follow a decade of service

Ten years is a relatively short period in the history of an organization, yet this tenth anniversary of the Ontario Ministry of the Environment provides a milestone by which to mark our progress, and to take a look at our future challenges and objectives.

The Ministry was established in 1972 to consolidate responsibility for all aspects of environmental protection, enhancement and restoration under one agency of the Ontario Government. In this brief span we have established a strong public service framework within which the public, industry and government co-operate to produce a better environment.

I feel that we can be proud today in acknowledging some of the progress we've made to meet a number of our objectives, particularly within the Ministry's water, air and waste management programs.

Ontario residents today are served by communal water and waste water facilities which are among the finest anywhere. Communal water systems are now providing drinking water to 98 per cent of Ontario's urban population, while communal sewage systems serve 94 per cent.

Since 1972, when the Canada-U.S. agreement was signed to restore water quality in the Great Lakes, Ontario has played a major monitoring role in this massive clean-up program. At our main laboratory in Rexdale, samples are analyzed for 58 different water quality parameters. During 1981-82, the laboratory performed roughly 120,000 tests on the Great Lakes alone. Phosphorus removal at all sewage treatment plants on the shores of the Great Lakes and its tributaries has brought nutrient loadings from spot sources under control. Considerable water quality improvements have been achieved in once heavily stressed areas of the lower Great Lakes. We have achieved our phosphorus removal objectives, and have moved on to increased commitments to help restore the lakes.

Intensive water sampling programs have been carried out to ensure that water quality standards are being met in our recreational lakes and watersheds. The Ministry's province-wide fish testing program on behalf of sports fishermen and consumers is unique in North America. The newest edition of the "Guide to Eating Ontario Sport Fish" reports on fish in more than 1,100 Ontario lakes and rivers.

Our air management program has been increasingly effective. We now operate about 1,400 air quality monitoring instruments across the province which measure 30 common known contaminants and a wide range of other contaminants on a special study basis. A unique mobile air monitoring unit (TAGA 3000) provides instant, on-the-spot analysis of air quality, representing a breakthrough in atmospheric analysis.

Since 1968, sulphur dioxide levels in Metropolitan Toronto have been reduced by 80 per cent and levels of particulate by 50 per cent. These pollutants have also been reduced significantly in all of our other industrial communities. Under the Ministry's comprehensive program of air quality control, industry in the province has spent more than $1 billion for air pollution abatement.

The Ministry has spearheaded efforts to involve federal agencies in both Canada and the United States in the search for solutions to the acid rain problem and the Ministry is participating in the drive to establish international working abatement programs.

Virtually every branch of the Ministry is involved in the complex research effort required to determine sources, deposition, effects, more effective abatement actions and to present our case in the international forum. Since 1979, Ontario has invested more than $20 million on scientific investigaton, legal activities and abatement strategies to deal with the long range transport of air pollutants. Ontario's major sources of acid rain causing $SO_2$ emissions are subject to control orders. Accordingly, Inco must reduce such emissions to 1,755 metric tonnes per day in 1983, from 2,250 tonnes per day permitted in 1980. Ontario Hydro must reduce its emissions from a level of 509,000 tonnes in 1981 to 260,000 tonnes in 1990 regardless of any growth in power production.

We have also made headway in our objective to improve waste management practices, including the development and introduction of stringent regulations for waste handling and disposal. Since 1970, when the province assumed responsibility for regulation of waste disposal sites, some 500 undesirable sites have been closed and the majority of the rest have been upgraded. In addition, as a precautionary step, we have surveyed and identified more than 1,400 waste sites which were closed or abandoned before the province assumed control, and these have been rated according to their former use.

A Crown corporation, the Ontario Waste Management Corporation, has been created for the development of a province-wide system for the treatment and disposal of industrial waste.

We have made a major commitment to resource recovery, with the objective of reclaiming as much solid waste as possible as a material and energy source. The Ministry is providing assistance to municipal recycling projects and the Ontario Centre for Resource Recovery, which came on stream in 1978, is now developing improved technology for waste recovery and is opening new markets for reclaimed materials.

Over the decade, the Ministry has performed pioneering work in a number of diverse activities consistent with our mandate. These endeavours include such advanced legislation as the Environmental Assessment Act, 1975, which established a system for early review of major projects at a stage when they can be changed to satisfy environmental concerns. We have streamlined approval processes and public hearings under the Consolidated Hearings Act, 1981. Other innovative activities include the development of municipal models for noise pollution control, our work in phytotoxicology, atmospheric research and modelling, and especially on long range transport of air pollutants we have developed several advanced techniques now used in our analytical and research laboratories.

Our main laboratory in Rexdale received visits from delegations and scientists from many lands, including Britain, China, the United States, Hungary, Australia and Poland.

Since 1972, more than 11,500 persons have attended our training courses, 6,500 of whom came from outside our Ministry, including scientists and technicians from other provinces and countries.

Improvements in our analytical research capabilities have served to alert us to new toxic contamination, which was undetected or unsuspected 10 years ago. These newly discovered conditions have created new challenges which we are meeting by the development of new objectives and programs.

It is important to recognize that more than 30,000 chemical compounds are being produced by industries located in the Great Lakes Basin alone and two or three thousand new substances enter the industrial stream each year. These chemicals and trace metals can accumulate in plant, animal and fish tissues, and can pass through the food chain to affect humans. In addition, when these chemicals are dispersed in water or ambient air we do not yet fully understand their synergistic effects.

The Ontario Government is pressing the Federal Government, to join the Ontario Government, industry and the scientific community in the establishment of a world-class centre for toxicology to explore immediate and long-term solutions to industrial chemical problems.

While we are able to look back on our Decade of Progress with pride and some satisfaction, we must look ahead in the knowledge that our task will never be completed and we must work even harder.

We realize that much remains to be done to ensure a safe and healthy environment, and that more determined efforts will be needed from all of us — government, industry and the individual — to meet the challenges of our second decade.

Ontario

Ministry
of the
Environment

Hon. Keith C. Norton, Q.C.,
Minister

Gérard J. M, Raymond
Deputy Minister

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Editor ....................Robert Koci

Director of Information Services ..................R.J. Frewin

(photo: Tessa Buchan)

**Representing the 2000 employees of Environment Ontario are: (top, left to right) Jim Bach, maintenance technician; Richard Mueller, water treatment plant operator; Cecil Wilson, project manager; (middle row, l. to r.) Lorna Gentles, clerk; Keith Norton, minister; Elaine Abisaleh, technician; (bottom, l. to r.) Martha Thomson, technician; Lorraine Post, scientist.**

Environment Ontario

# legacy

**July 1982** **Vol. 11, No. 1**

*Special edition in commemoration of the tenth anniversary of the Ontario Ministry of the Environment.*

## CONTENTS

# Children explore the environment

In answer to well over 400 requests. Environment Ontario will continue its Environmental Explorations program in 1982. During the summer season, three teams of two students each will travel over northern and southern Ontario teaching environmental education in elementary schools in May and June and in parks and camps in July and August. Two of the crews will be bilingual.

The crews activities include soil, aquatic habitat insect and litter and nature studies and environmental games. An acid rain study designed for older children has been added this year. In the parks, films about the ministry's programs and the preservation of the environment will be shown.

Environment Ontario's Environmental Explorations program was started in 1976. In that year, 21 locations were visited by one crew. By 1981 three crews made 161 visits reaching an estimated 54,663 people.

**Young people of all walks of life have followed with great interest the Environmental Explorations program.**

# APIOS reports on the sensitivity of 2624 lakes

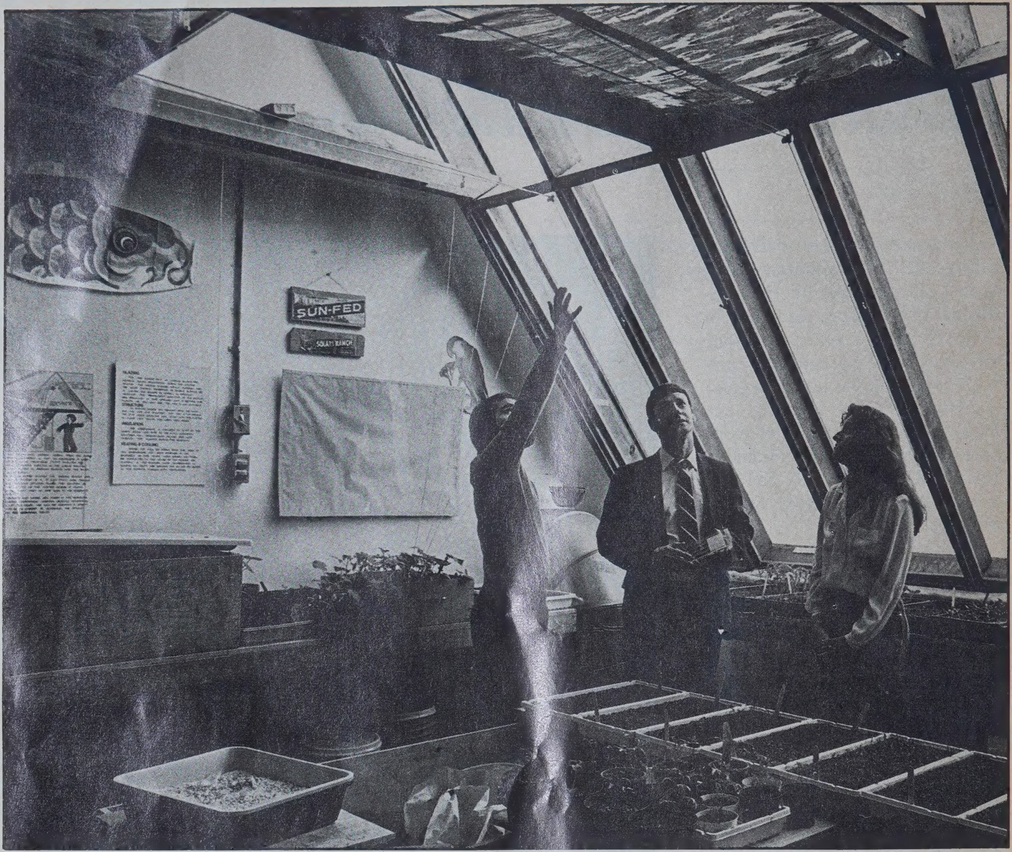
Environment Ontario has published its second summary of acid sensitivity of lakes throughout Ontario as part of its ongoing Acidic Precipitation in Ontario Study (APIOS). The survey lists the sensitivity of 2,624 lakes, of which 959 lakes have been surveyed since May 1981.

The condition of these lakes is classified on a scale of 1 (zero or negative alkalinity) to 5 (not sensitive). The summary provides data for the determination of future trends and can act as a guide to the status of recreational waters.

In addition, the summary contains tables giving the number and classification of lakes by county and district and maps showing general lake sensitivity as predicted by the geological composition of their environment and the location of precipitation sampling sites in Ontario.

Copies of the summary and additional information are available from Environment Ontario, Information Services Branch, 135 St. Clair Avenue West, Toronto, M4V 1P5.

# Ceiling comes down in Ecology House




**Dave Coon and Debbie Grindstead of Energy Probe explain to visiting Environment Minister Keith C. Norton how the insulated ceiling of the Ecology House's hydrophonic room is lowered at night to improve insulation and conserve energy.**

(photo: Tessa Buchan)

# First municipal environmental assessment

Ontario Environment Minister Keith C. Norton has received the first environmental assessment submitted by a municipality since the application of the Environmental Assessment Act was extended in 1980 to include larger municipal projects. The assessment was prepared by the Borough of Scarborough and involves storm water management in the Morningside tributary watershed of the Tapscott industrial district.

"The review of the assessment, co-ordinated by the ministry does not represent a decision," Mr. Norton said. "It is intended to assist the public in its consideration of the environmental assessment and of the undertaking. The review presents a preliminary position based on the comments of the staff of provincial ministries and agencies involved."

Concerned citizens may make written submissions to the minister including a request for public hearings under the Environmental Assessment Act after reviewing Scarborough's environmental assessment document.

## More money for termite control

Funding for Ontario's termite control program for 1982-83, has been increased to $500,000 due to the unexpected increase in applications for assistance, Environment Minister Keith C. Norton announced.

The Environment Ministry established the grant program in 1975 as an incentive for communities and homeowners to deal effectively with the problem of termite infestations. It applies to homeowners in Ontario municipalities which have adopted local by-laws for termite control.

Mr. Norton explained that while the ministry had expected an increase in demand because of growing public concern and more municipal inspections, it had not anticipated the response which has already accumulated for the new fiscal year.

## Legacy goes international

The copy of LEGACY you are now reading is read far beyond Ontario and all the other provinces of Canada. A recent check of our subscription list has shown that this publication of the Ontario Ministry of the Environment has readers in 31 countries — most of them in organizations and individuals involved in environmental work.

In addition to 332 subscribers in the U.S., LEGACY finds its way to universities, engineering associations, libraries, editorial offices and government agencies in all countries in Western Europe and to some more exotic locations like Sri Lanka, India, Korea, Malaysia, San Salvador, Saudi Arabia, Papua, Tanzania, Uruguay and Venezuela. One of the more recent requests for a subscription came from the library of the Soviet Academy of Sciences in Moscow.


**S.I.U.-men (l. to r.) Ray Brown, Mark McKenny, Jim Bagshaw, Jim Gallagher and David Kerr leave Environment Ontario's head office after a briefing to return to their regional hunting grounds.**

(photo: Tessa Buchan)

# Environmental police in action

## by Jo-Anne Thomas

In its first year of operation, the Ministry of the Environment's Special Investigations Unit (SIU) was involved in an impressive 328 investigations. The unit's 13 officers are actively enforcing environmental law as they stake out illegal dump sites, clean up hazardous spills and testify in court cases.

The SIU was formed in January, 1981, to provide the ministry with an environmental police force well versed in courtroom procedure and able to conduct investigations and collect evidence.

Members were selected from ministry staff. Of the many applicants, 13 were chosen. The successful applicants were sent to the Ontario Police College in Aylmer for training.

All SIU officers are designated Provincial Offences Officers; as such they have special powers under the Environmental Protection Act, the Environmental Assessment Act, the Pesticides Act and the Ontario Water Resources Act.

*police assistance available*

They have the right to enter any premises where they suspect a violation of one of the acts, to examine any books, documents or records necessary to their investigation and to remove samples, copies or extracts of any document.

They can get police assistance to enter premises to carry out their duties. No person is allowed to hinder them in the performance of their duties or to refuse to furnish information or to give false information. The officers, in turn, must maintain absolute secrecy about any information they have obtained during an investigation.

Environmental officers in industrial, municipal and private abatement are also designated Pro-

vincial Offenses Officers and have the same power as members of the SIU. The major difference between SIU members and environmental officers is that the SIU is concerned with enforcement rather than abatement.

Members of the SIU are mainly involved in the surveillance of waybill operators and the handling of liquid industrial waste.

## special rather than routine investigation

Environmental officers are involved in technical investigations such as the calculation of emissions and the pollutant loading of discharges.

Roger Howe, supervisor of the SIU, West-Central Region, says: "The emphasis of the SIU is on special investigations rather than routine investigations. We have the time to thoroughly investigate specific cases. Environmental officers also investigate but they have many other responsibilities. Enforcement is only a small part of their jobs."

"We try to work closely with the other sections to our mutual benefit. We have a common goal, which is to protect the environment," Mr. Howe said.

Ray Duguay, co-ordinator of the SIU, says: "The mandate of the SIU is the enforcement of environmental law. But we don't just go around threatening people with prosecution. We are willing to assist industry and to advise them on how to handle their problems before they become environmental hazards."

Mr. Duguay knows what he is talking about. He is an Ontario Provincial Police officer. He has been with the OPP for 16 years and will resume his job as detective-sergeant with the anti-rackets branch on completion of his assignment to Environment Ontario.

The SIU officers are attached to the ministry's regional directors' offices. There are four SIU officers in Central region, four in West-Central region, two in Southwestern region, one in Southeastern region, one in the Northeastern and one in Northwestern region.

They undertake investigations assigned to them by their regional directors or recommended by environmental officers in industrial or municipal and private abatement.

In the first year of operation the SIU has accumulated an impressive track record. Members made 213 investigations and assisted environmental officers on 115 others. In addition, they conducted 88 surveillances and investigated the operations of 1,029 transporters of liquid industrial waste. The SIU was responsible for laying 114 charges and assisted in a further 116, for a total of 230 charges. The courts have made decisions on 88 of these cases, resulting in 71 convictions. There are still 99 cases before the courts and 43 charges have been withdrawn.

"We are interested in solving problems and preventing pollution any way we can, whether that is by prosecution or co-operation," says Mr. Duguay. "One of our major problems is the hit-and-run dumper who knows he is breaking the law but does it anyway. We would like to see this type of person charged but we will work with anyone who is concerned with the environmental problems that industry may be causing."

## many tools are used....

The SIU uses various tools in its work. One of them is photography. Photographs are useful as evidence in court trials. The SIU also uses the ministry's Operation Skywatch in taking aerial photographs.

The SIU is improving its mobile communications facilities by installing radios and telephones in cars.

Investigations and surveillances play an important role in enforcing environmental law.

## some cases are very complex

"In the case of a discharge, we have to show that the discharge is unlawful. We have to show that the discharge is a contaminant and what that contaminant is. In instances where there are many industries in one area we have to prove beyond a doubt who the guilty party is," says Mr. Duguay.

"Some of these cases are complex and require detailed investigations and scientific testing of evidence. In some ways you could compare our investigations with that of a complex murder case."

The SIU officer must be careful in collecting sufficient evidence. He has to rely heavily on scientific test results from the ministry's laboratories. He must also talk to witnesses and thoroughly prepare his cases. This speeds up court cases and results in fewer dismissals.

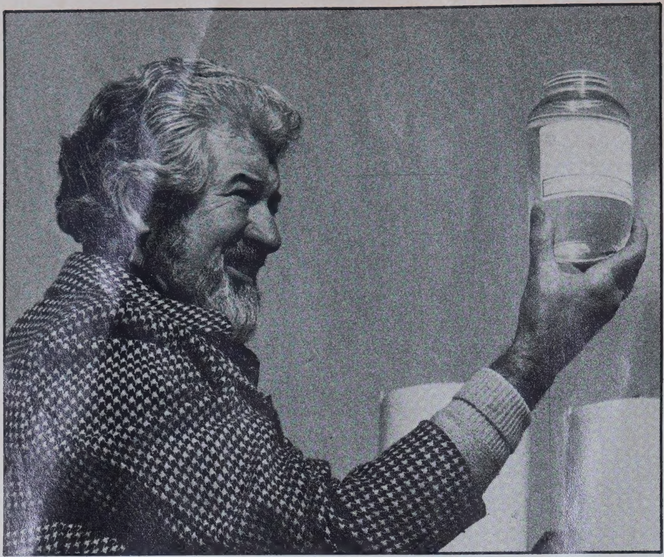
Since its inception, the SIU has proven to be an effective enforcement unit. Its success has resulted in the assignment of 29 more environmental officers to the police training course at Aylmer.

The SIU members are not the only ministry officials conducting investigations and enforcing environmental law but they have contributed significantly to the ministry's efficiency rate regarding prosecutions.

"SIU officers have demonstrated that they are capable of effectively doing the job they were chosen for," says Mr. Duguay. "Their record in the past year promises even more success in the future."

# Of clouded samples

by John Steele



**Jim Lauder finds a clouded sample...** (photo: John Steele)

A day in the life of Jim Lauder, senior industrial environmental officer with the ministry's Kingston district office, could mean a visit to a cheese factory, a chemical or aluminum-making plant, or heading in the middle of the night to the scene of a disaster on busy Highway 401.

"I can do without the disaster part quite nicely," said Mr. Lauder. "But oil spills and other accidents never seem to occur during normal working hours."

Today he is heading for the Harrowsmith Cheese Factory located in the small community of Harrowsmith just north of Kingston. The factory produces quality cheese. Mr. Lauder likes both — cheese and the people who run the factory.

Born and educated in Scotland, Mr. Lauder has worked for the Ontario Government since 1969. He lives in Collins Bay, west of Kingston, with his wife and four children.

Mr. Lauder looks after Frontenac County. Since April 1 last year, he and his staff have investigated 224 industrial complaints besides doing their routine sampling inspections and testing of area industry effluents and emissions. Industrial plants in the area come in all sizes — from Alcan's giant aluminum plant and the equally big Dupont chemical facility to the Harrowsmith cheese factory.

Cheese factories are a part of southeastern Ontario's dairy industry. Their products are sold locally and around the world.

"Ontario produces very good quality cheeses," said Bob Jardine, a cheese-making expert with the Ministry of Agriculture and Food. "At one time cheddar was the mainstay of the industry, but today Ontario cheesemakers have adapted to changing tastes and produce an assortment of cheeses like provolone and mozzarella."

Industrial milk purchased from the Ontario Milk Marketing Board is used to produce cheese. The milk is colored with a vegetable dye and heated in a vat to 86.5 degrees Fahrenheit. A bacteria culture is introduced to produce lactic acid. Rennet, a chemical, is put into the milk to make it coagulate.

The milk pudding is then cut into small cubes and allowed to mat at the bottom of the vat. The whey, or watery substance covering the vat is drained off. The cheese is salted, cut into slabs, put into hoops and pressed into the familiar wheels.

"Whey is the waste product in the cheese manufacturing process that can cause environmental problems unless it is controlled," said Mr. Lauder.

An average size cheesemaker can generate more than a ton of whey each day. It contains a high level of biological oxygen demanding (BOD) substances which, when emitted into a watercourse, can rob streams of life-giving oxygen.

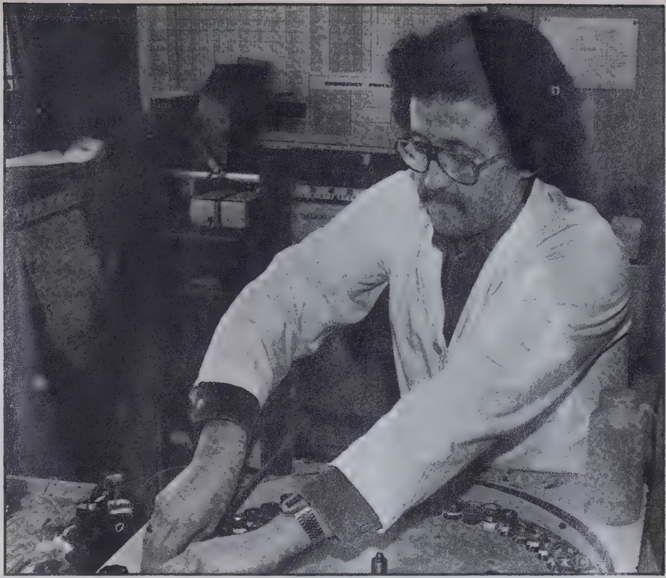
The Harrowsmith Cheese Factory removes the moisture from its whey by using a condenser. The solid portion of the condensate, rich in milk protein, milk sugar and dissolved salts, is shipped to a local food producer. The relatively harmless effluent enters a small stream that meanders through the community.

To make sure the effluent is safe, ministry staff collect samples and inspect the plant routinely. Today Mr. Lauder fills his sample bottle with effluent. The sample is a little cloudy and he worries that the factory may have had some malfunction. He talks to the plant manager about it. The manager is surprised and requests the results of the analysis of the sample back as quickly as possible.

At the office, Mr. Lauder asks the lab to analyze the sample as soon as possible. He asks for P.H., suspended solids, BOD, total solids, dissolved solids, phosphorus, and chemical oxygen demand (COD) data.

# and clean laboratories

### by Jo-Anne Thomas



**and in the lab Jerry Hinckley determines why...** (photo: Penny Stewart Racey)

When Jim Lauder or any one of the inspectors of the industrial abatement section brings a sample of effluent for analysis to the Ministry of the Environment's regional laboratory in Kingston, he starts a process that will end only when the results have been recorded and double-checked for accuracy.

The sample is given a laboratory number. This number is entered on a worksheet along with the tests requested by the field officer. The laboratory technicians then start to analyze Mr. Lauder's sample for the seven parameters he requested.

The Kingston laboratory is small but efficient. It can perform all routine tests. Only samples requiring complex testing for materials such as hydrocarbons and heavy metals are sent to Toronto.

Last year, the Kingston laboratory performed 109,689 chemical tests and 51,783 microbiological tests.

Samples are tested for a wide variety of parameters depending on the source and the reason for which they were collected. The Kingston laboratory can analyze samples for approximately 28 parameters including biological oxygen demand, chemical oxygen demand, coliforms and alkalinity.

The first step in processing the cheese factory effluent sample is a pH or acidity test. A technician inserts a meter into the liquid and reads the pH off the scale. A reading under 7 indicates that the sample is acidic.

The next step involves filtering a portion of the sample, drying the filter and weighing it. The results of this test indicate the amount of suspended solids the sample contains.

To find out the amount of the total solids, the technician evaporates 50 millilitres of the sample and calculates the weight of any residue. The concentration of dissolved solids is then given by a simple mathematical calculation. The total solids minus the suspended solids equal the dissolved solids.

To determine the phosphorus content, the laboratory uses an automated system which mixes acid and an oxidizing agent with the sample. The sample turns blue and the phosphorus content is calculated by the intensity of the color.

The sample then goes into an incubator where after five days it will be analyzed for BOD or biological oxygen demand. A reading of 15 BOD is considered satisfactory. COD or chemical oxygen demand is calculated by an oxidization process in which the chemical is forced to use oxygen to allow the calculation of the demand on oxygen the chemical would have if it were released in a stream.

The job of the laboratory does not end when all the tests are completed. The results must be assessed and compared to results from any previous tests. If there is any doubt about the accuracy of the tests, another sample must be taken and the process starts again.

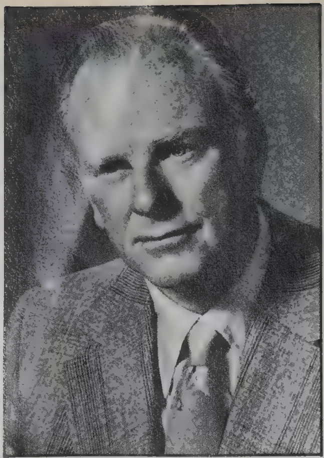
The Southeastern Region laboratory has the smallest area and the least number of employees of all the regional laboratories.

"This laboratory allows us to provide a good analytical support to our field officers," said Stan MacBeth, chief of laboratory services. "Samples can be analyzed quickly and we have a reservoir of information available which enables us to better interpret the results of tests and provide reliable information to our field officers."

The tests done on the sample of effluent from the Harrowsmith Cheese Factory showed that it was acceptable according to Ministry of the Environment standards except for a slightly higher reading of pH.

This was reported to the company's plant manager who adjusted the production process to prevent further unacceptable acidity levels.

# The men in



## George A. Kerr

**April 1971 to April 1972 (Department of the Environment)**

Was responsible for the Ontario Water Resources Commission when the legislation was developed for the establishment of the Ontario Ministry of the Environment.

Signed the Canada-Ontario Great Lakes Agreement.

**October 1975 to June 1978**

Introduced container regulations. Initiated monitoring and information programs on contaminants in fish. Established Hazardous Substances Committee and industry-wide program of pollution control in the pulp and paper industry. Developed a model noise by-law. Put first mobile air monitoring unit on the road.

Signed the federal-provincial accord on environmental protection and revised the Canada-Ontario Agreement on the Great Lakes.

## James A.C. Auld

**April 1, 1972 to February 1974**

First Minister. Established pollution abatement research grants to universities, industries and consultants. Established solid waste task force to find ways to reduce solid waste and minimize the effects of its disposal. Established the regional structure of the ministry and pesticide control regulations and procedures.

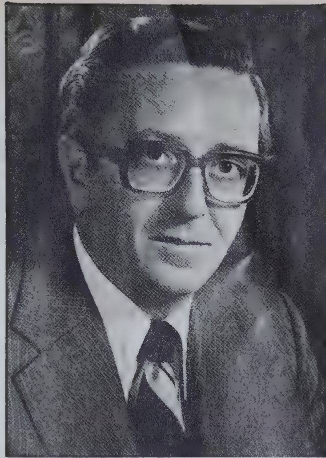
Was present at the signing of the Canada-U.S. Agreement by Prime Minister P.E. Trudeau and President Richard Nixon.

## William G. Newman

**February 1974 to October 1975**

Established waste management regulations for private sewage treatment and disposal. Started construction of the York-Durham Water and Sewage System. Introduced regulations establishing criteria for 23 air contaminants and emission standards for 84 substances. Introduced Ontario Environmental Assessment Act. Officially opened and expanded comprehensive environmental research and laboratories facilities.

# the spotlight



## George McCague

**June 1978 to August 1978**

Expanded air pollution index network. Launched Environment Ontario publication of ''Guide to Eating Ontario Sport Fish''. Opened the Ontario Centre for Resource Recovery.

## Dr. Harry C. Parrott

**August 1978 to April 1981**

Launched major action plan to meet the challenge of acid rain in Ontario. Established six-point action plan to deal with the issue of liquid industrial waste. Officially opened Phase One of the York-Durham System. Extended environmental assessment to municipal projects. Established funding for municipal and private source separation and recycling projects.

Was present at the signing of the second Canada-U.S. Agreement by U.S. Secretary of State Cyrus Vance and Minister of External Affairs Don Jamieson.

## Keith C. Norton, Q.C.

**April 1981 —**

Took acid rain fight to the United States. Brought U.S. legislators, politicians and journalists to Ontario to get a federal and provincial perspective on the effects of acid rain. Intensified monitoring and study of toxic contaminants in Niagara River and Lake Ontario. Established special Niagara River Improvement Team.

# The ten-year battle for a cleaner world around us

by Jane Watson

The Province of Ontario was one of the first jurisdictions in the world to develop a comprehensive program of environmental protection, rehabilitation and management.

In 1956, the Ontario Government created the Ontario Water Resources Commission (OWRC) to guarantee a good supply of drinking water anywhere in the province and to keep Ontario's rivers, lakes and groundwater free from pollution.

The commission soon became known as a make-things-happen pollution control agency and, with the passage of the Ontario Water Resources Act, became one of the most legally powerful commissions in the world.

## DEPARTMENT OF ENERGY AND RESOURCES MANAGEMENT

Air quality in Ontario was initially the responsibility of individual municipalities. In 1956, Metro Toronto created a division to control air pollution over a 240-square-mile limit, built a laboratory and passed and subsequently enforced a stringent bylaw. Most Ontario communities, however, did not have the expertise or the finances to operate such a program.

In 1967, the Ontario Legislature passed the Air Pollution Control Act. The Act gave the province the most comprehensive air pollution control program in Canada. The program was administered by the air management branch of the Department of Energy and Resources Management (DERM).

Prior to 1971, municipalities, industries and, in some cases, individuals developed their own programs and facilities for waste management and disposal. Economics, availability of sites and ease of disposal received precedence over environmental considerations.

In 1968, the waste management section of the Department of Health was transferred to DERM to investigate the problems associated with solid waste management.

In 1970, the branch assumed responsibility for administering the new Waste Management Act which gave the provincial Government complete control over all solid wastes hauled away for disposal.

## DEPARTMENT OF THE ENVIRONMENT

In 1971, the Department of Energy and Resources Management became the Department of the Environment. The name change reflected a shift in emphasis from the utilization of natural resources to the preservation and protection of the province's natural heritage.

In accordance with this change in philosophy, the Environmental Protection Act, 1971, was passed to provide a firm base for regulation and enforcement in all aspects of environmental control.

That same year the pesticides control service and the private waste management branch joined the new department. They had formerly reported to the Department of Health.

## MINISTRY OF THE ENVIRONMENT

In 1972, the provincial Government assembled the various components of all of its environmental programs within the sphere of one agency. Thus, the Ontario Water Resources Commission and the Department of the Environment were consolidated into the Ministry of the Environment.

At the time of the consolidation, the OWRC had a staff of 1,247 (383 were operators in sewage and water treatment plants), and the Department of the Environment employed 400. (This figure does not include the conservation authorities branch which was transferred to the Ministry of Natural Resources.)

Each of the five divisions had its own regional and district offices. In addition, the air management branch had a laboratory in downtown Toronto and the OWRC had a central lab in Rexdale and regional labs in London and Thunder Bay.

In 1974, the ministry reorganized its internal structure to make its services more accessible to the public and to meet the various challenges of every sector of the province.

The realignment created six regional offices in Thunder Bay, Sudbury, London, Hamilton, Don Mills and Kingston, plus 23 district offices.

Environment Ontario's staff today numbers 2,100 with 583 of these working in sewage and water treatment plants.

## AIR QUALITY

Under the ministry's program of air pollution control, industry in the province has spent or committed more than $1 billion for air pollution abatement since 1972. This has resulted in a great improvement in the air quality of Ontario cities.

Environment Ontario operates more than 1,250 air quality monitoring instruments located in 125 areas across the province, which measure 30 common known contaminants on a special study basis.

In 1981, the United Nations Organization for Economic Co-operation and Development (OECD) reported Toronto's air pollution and levels of sulphur dioxide ($SO_2$) and particulates as the least of any major industrial city in the OECD countries. This is the result of a decade of abatement action in Toronto, as well as in other industrial centres throughout Ontario.

Since 1970, the levels of $SO_2$ in downtown Toronto have dropped 80 per cent, while carbon monoxide has decreased 40 per cent and suspended particulate matter 50 per cent.

In Hamilton, suspended particulate matter, the city's major pollutant, has decreased in levels ranging from 21 to 58 per cent across the city, mainly as a result of the abatement of emissions by the steel industry. Between 1970 and '78, emissions of particulate matter have decreased 50 per cent.

Sudbury's major pollutant is sulphur dioxide. Concentrations have decreased 75 per cent.

The air quality of other industrial cities such as Windsor, Welland, St. Catharines and Cornwall has also improved markedly since 1972.

## AIR POLLUTION INDEX AND ALERT SYSTEM

Ontario's Air Pollution Index and Alert System was established in 1970 to give warning of, and to prevent the adverse effect of air pollution build-ups by curtailing the operations of major sources of air pollution when climatic factors indicate a build-up may take place. The index covers Toronto, Sarnia, Hamilton, Windsor, St. Catharines, Niagara Falls, Sudbury and the nearby community of Coniston.

Since the inception of the API, the number of occasions on which the API exceeded the advisory level of 32 has dropped in Toronto from 18 in 1972 to zero in '82. Similarly, in Windsor, where the advisory level was exceeded nine times in '72, and in Sudbury, where the level was reached 26 times in '71, there were no exceedences in '82.

## AIR POLLUTION AND THE AUTOMOBILE

The Ontario Ministry of the Environment is the only ministry in Canada which has legislation to control automotive pollution province-wide. Regulations introduced in 1969 preceded federal government regulations by two years.

To ensure compliance the ministry established an auto emissions inspection program in 1971. Since that time, Environment Ontario inspectors have analyzed exhaust

**Inco's tall stack, built in 1972, improved the quality of the local air. The stack's designers did not suspect then that it would cause acid rain damage elsewhere.**

gases and performed inspections on over 6,000 cars a year.

## AIR POLLUTION AND PLANTS

Environment Ontario is the only agency in Canada with a comprehensive phytotoxicology program. Qualified staff investigate suspended air pollution injury to vegetation, forests, orchards, field crops and ornamental plantings.

A new research laboratory, opened in 1981, is the largest clean-air greenhouse and growth chamber facility in Canada.

## INDUSTRIAL WASTES

All major industries in the province are engaged in pollution abatement programs. Environment Ontario staff conducts intensive sampling to see that these programs are on schedule. To date, industry has spent more than $500 million to meet ministry requirements in water pollution control.

Through ministry action, all substantial mercury discharges to waterways from mercury cells in pulp and paper operations have been eliminated. In 1970 there were six mercury cell chlor-alkali plants in Ontario.

Today only the C.I.L. plant in Cornwall operates a mercury cell chlor-alkali plant, but its discharges meet federal discharge regulations consistently.

## LIQUID WASTE DISPOSAL

The safe and environmentally sound treatment and disposal of liquid industrial wastes is a major priority in Ontario. Until the late '70s, the treatment and disposal of liquid industrial wastes and hazardous wastes were considered the responsibility of the private sector.

In 1981 Environment Ontario entrusted the planning and development of a major facility for the management of liquid industrial wastes to the Ontario Waste Management Corporation. The chairman of the corporation is Dr. Donald Chant.

Regulations under the Environmental Protection Act provide for an improved waybill system to track wastes. These include the monitoring of all liquid industrial wastes and all hazardous wastes, solid and liquid; the registration of all waste generators and their waste streams; and, ticket-like fines for minor infractions of waybill regulations.

A 13 man environmental policing unit now exists to investigate and prosecute cases of illegal dumping of industrial and other hazardous wastes.

The ministry's legal staff was expanded to handle the increased number of prosecutions and control orders.

Environment Ontario is also involved in the research and development of new waste treatment and disposal technology. In 1980, it committed $1 million to diverse research projects.

## SOLID WASTE MANAGEMENT

In 1972, the ministry embarked upon a continuing program of recording, certifying and improving or closing existing waste disposal sites. To date, some 500 undesirable sites have been closed and a majority of the rest have been upgraded.

In 1980, Environment Ontario, with assistance from the public, carried out a study designed to locate waste management sites that were closed prior to 1971. After a province-wide search of historical records and public memory, 1,450 sites were discovered; 197 were marked for further study.

In addition environmental consultants investigated 50 privately-owned industrial waste sites across Ontario. Fifteen sites were still operating and the balance were closed sites. Further investigation and remedial work was ordered on 11 sites and 26 sites were marked for more monitoring and study.

## RESOURCE RECOVERY

In 1978, the Ontario Centre for Resource Recovery was constructed in Downsview. It is a unique research facility developing and providing both the technology of waste recovery and new markets for reclaimed materials.

The ministry is conducting research such as the demonstration project at Canada Cement LaFarge in Woodstock, where refuse from the Ontario Centre for Resource Recovery is being used as a fuel supplement.

The ministry also provides financial support and assistance for community or municipal recycling projects.

## NOISE

In Ontario, The Municipal Act gives municipalities the power to pass its own bylaws to control noise.

In 1974, Environment Ontario created its unique noise control section which developed a Model Municipal Noise Bylaw to assist local areas in regulating noise. Seventy municipalities in Ontario have now adopted noise control bylaws.

## HAZARDOUS SPILLS

The 600 industrial spills handled by the ministry yearly involve about 1,250,000 gallons of oil, gasoline, toxic chemicals and other potentially hazardous substances. Another 8,000,000 gallons of less harmful liquids and significant quantities of solid and gaseous contaminants are also dealt with.

Environment Ontario believes in spill prevention. It has had a leading role in developing industrial and regional contingency plans and contingency groups and in the containment and clean-up of accidental spills of hazardous substances.

## PESTICIDES CONTROL

To ensure the safe use of pesticides Environment Ontario applies regulatory and other classification systems controlling the sale, distribution and use of these substances. The ministry enforces bans and restrictions on such insecticides as heptachlor, aldrin, dieldrin and DDT.

The ministry also administers special provincial pest control programs such as the control of household cockroaches, termites and mosquitoes.

The two aerial photographs show clearly the difference between the old type garbage dump and a landfill site as it is operated under control of Environment Ontario since 1972. (photos: Ron Johnson)

## WATER MANAGEMENT STUDIES

Over the last half decade the Ministry of the Environment, in co-operation with other ministries such as the Ministry of Natural Resources and various conservation authorities, has taken the lead in the development of water management plans for large river basins and nearshore areas. Conflicting water uses require comprehensive evaluations of existing resources and environmental impact analyses of proposed water management alternatives.

In addition, areas such as Hamilton Harbor and Toronto Harbor are being examined from a chemical, biological and physical point of view to develop recommendations for the proper management of these resources.

## GREAT LAKES

Ontario has led the way in pollution control programs to restore and maintain a high level of water quality in the Great Lakes.

It initiated the agreement between Canada and the U.S. to clean up the lakes and to establish an international agreement for protection in the future.

The signing of this accord in 1972 paved the way for a number of programs to accelerate improvement and reverse deterioration in our richest freshwater reservoir.

For example, policies and abatement programs are now being developed regarding urban stormwater — a significant source of pollution.

In the late 1960s, phosphorus was considered a serious threat to water quality in the lower Great Lakes. In response, Ontario spearheaded the installation of phosphorus removal equipment in every major sewage treatment plant in the area.

With installation now complete in 214 plants and phosphorus levels regulated to one part per million in treated sewage, Ontario possesses a municipal program unparaleled anywhere in the world.

Major advances in the water quality of the Great Lakes include: a significant decrease in the phosphorus levels of Lake Ontario and Western Lake Erie; a progressive reduction of contaminants such as mercury, DDT and PCBs in many sport, commercial and forage fish species; a dramatic improvement since 1968 in the water quality and biological communities of the St. Clair River; and, a sustained improvement in the bacteriological quality of the recreational waters of Lake Ontario.

## RECREATIONAL LAKES

The ministry is concerned about the state of the waters around the province's 250,000 cottages.

In a ministry-run survey started in 1970, the septic systems of 20,000 cottages on the Rideau system from Ottawa to Kingston, the Thousand Islands area and the Trent Canal system have been inspected. In addition, a number of lakes across southern Ontario and the Lake of the Woods at Kenora are under study. Water quality standards are checked regularly by ministry staff.

Environment Ontario, in co-operation with the Ministry of Natural Resources, collects fish from all popular angling areas in Ontario and tests them for trace contaminants such as mercury, PCB, Mirex and DDT. The findings are published in Environmental Health Bulletins and summarized in annual bilingual booklets entitled "Guide to Eating Ontario Sport Fish".

Approximately 54,000 fish from over 878 waterways have been tested and reported to date.

## LABORATORY SERVICES

For every visible activity the ministry undertakes, a vast amount of analytical work is essential. It is performed by the ministry laboratory in Metropolitan Toronto and in its regional laboratories in Kingston, London and Thunder Bay.

The ministry's main laboratory was constructed in 1960 and expanded at a cost of $11 million in 1974.

By the expansion, the lab became one of the largest and best equipped environmental analytical laboratories in Canada. The technical staff of the branch has extended from just over 200 scientists and support personnel in 1974 to over 375 in 1980.

Ministry staff undertake approximately 1,700,000 tests each year on samples of air, soil, and water as well as on animal, vegetable and mineral specimens across the province.

## RESEARCH

To assist the ministry's research, the Research Advisory Committee (RAC) was created in 1975. This committee is responsible for the administration of the Provincial Lottery Funds available for health-oriented environmental projects under the jurisdiction of the Ministry of the Environment. The committee is composed of representatives from the various branches and a medical advisor from the Ministry of Labour.

Since 1977, 50 projects have been assigned to universities and colleges, research foundations, municipalities, consulting companies and citizens groups.

## EDUCATION AND PUBLIC INVOLVEMENT TRAINING AND LICENSING

The ministry offers an extensive program for training and certifying the environmental staff of industry and government organizations as well as its own personnel. Approximately 50 courses are offered annually, covering waste and water treatment, industrial pollution abatement, acoustics technology, hazardous materials, emergencies and water disposal. Since 1972, over 12,000 people have completed these courses.

## CONFERENCES

The Ontario Industrial Waste Conference celebrated its 28th annual meeting in 1981. For the past nine years it has been sponsored by Environment Ontario.

The conference is devoted solely to industrial waste abatement and treatment. Its main objective is to expose the delegates to the latest developments in that particular

**In Environment Ontario's new phytotoxicology laboratory technician Al Hill takes care of young tobacco plants used in a study on the effect of certain air pollutants on vegetation.** (photo: Tessa Buchan)

field. Annual attendance has exceeded 600 for the past seven years.

In November of 1981, the ministry sponsored the Technology Transfer Conference No. 2. The purpose was to distribute information arising from Provincial Lottery Research Projects and from other ministry in-house and external research projects. Emphasis is placed on the useful application of these projects to investigative work carried out in the environment.

## TEACHERS WORKSHOPS

In 1978, the ministry conducted its first Annual Environmental Studies Workshop for Special Education Teachers. The weekend-long workshop is held each spring in Bolton, Ontario. There, teachers of exceptional children are taught how to adapt environmental learning activities to meet the needs of their students.

## OPERATION SKYWATCH

In 1979 the ministry called upon the skills and co-operation of the Ninety-Nines — an international organization of women pilots — to help it search out unusual environmental conditions through regular surveillance flights. Today, approximately 85 pilots volunteer their time and aircraft to carry out airborne environmental patrols over southern Ontario. The ministry provides the photographic equipment, film and training. The training covers land, water and air pollution, environmental law, flying and photography techniques and safety.

## FRENCH LANGUAGE SERVICES

The ministry appointed a full-time French Language Services Co-ordinator in 1980 to ensure full range of ministry services in areas of the province where there are significant concentrations of French-speaking Ontarians.

By 1981, bilingual staff were situated in ministry offices located in Cornwall, Ottawa, Peterborough, Stoney Creek, Sudbury, Timmins and Toronto.

Approximately 75 per cent of the ministry's general information and educational publications are available in French, including literature pertaining to major environmental issues such as acid rain and hazardous water.

# Five-vessel fleet monitors Great Lakes water quality

A fleet of five vessels monitors and samples water quality in the nearshore areas of the Great Lakes and their tributaries for Environment Ontario.

The flagship of the fleet is the 60-foot Guardian No. 1 which has diesel powered engines, a steel hull and laboratory facilities. Navigational equipment includes radar, VHF radio, depth sounder and gyro compass.

The Monitor IV and the Monitor II are smaller in size but have the same equipment as the Guardian No. I. The Monitor V and the Monark have similar equipment but have aluminum hulls, gasoline-powered inboard/outboard engines and magnetic compasses. Monitor V, Monitor II and Monark are trailable. All are painted in the ministry colors — green hull and white upperworks.

The boats are used from early May to late November surveying the Great Lakes and the major rivers which have an impact on the lakes.

In 1982 Lake Ontario is singled out for special attention

**Environment Ontario's monitoring fleet caught in its way to its winter quarters before freeze-up of Lake Ontario. F**

for the second year in a row. This monitoring program is part of the international surveillance plan of the International Joint Commission.

The season's work of the fleet will start with the annual spring survey on Lake Ontario's nearshore. The 26 ft. Monitor V and the 36 foot Monitor IV will cruise from Oshawa to Kingston testing the water for phosphorus and other nutrients.

Later, the Monitor V will be used on Lake Superior to conduct a survey of pulp and paper effluents in Thunder Bay. The other vessels will be assigned various tasks according to their availability and suitability.

Surveys geared primarily to monitor organic and inorganic trace contaminants will be conducted on the Niagara River, Hamilton Harbor, Toronto Harbor and the Bay of Quinte, all of which influence the water in Lake Ontario. These surveys only take from one to two weeks but are repeated frequently.

Testing for trace contaminants and biological sampling will be done on the St. Lawrence River.

Other major projects will include a bacteriological survey of the St. Clair River along the Sarnia waterfront with emphasis on Sarnia Bay. This survey is done to assess the suitability of establishing beaches in the area. Water quality, phenolics, carbons and solids will also be monitored.

Another bacteriological survey will be done on the Detroit River and along the Ontario shoreline from Windsor to Amherstburg. This survey measures the impact of municipal sewage discharges and assists in assessing the progress of the sewage separation program in the area.

Nutrients, phosphorus, biomass indicators and solids will be monitored four times this year in the western basin of Lake Erie as part of the Great Lakes International Surveillance Plan.

Another major project will be undertaken on the St. Marys River. There are two major concerns involved here: the assessment of the effects of Great Lakes power development and the assessment of industrial discharges; the water will be tested for phenols, cyanide, ammonia, bacteria and other parameters.

The largest boat, the Guardian No. I and the smallest boat of the ministry's fleet, the 21 foot Monark, will be used to test for radioactivity near Pickering and Serpent Harbor on the north channel of Lake Huron.

The fleet will also assess municipal and industrial discharges using the plume tracking method. This method enables the crew to determine the extent of a plume of effluent in a water body. Some of the sewage treatment plants that will be monitored are Duffin Creek, Humber, Main (Toronto) and Highland.

**left to right: Guardian No. 1, Monitor II, Monark, Monitor IV and Monitor V.**

**On a site adjacent to Environment Ontario's acid rain laboratory in Dorset, a wide variety of instruments are deployed for the sampling of precipitation. Some of the instruments are being tested before their installation at**

# Acid rain lab complex grows

The growing concern about the effects of acid rain is reflected in the expansion of Environment Ontario's laboratory in Dorset for scientific research into the phenomenon.

A year ago the Dorset lab consisted of three crowded trailers in which space for the various scientific projects under way was at a premium. Today the ministry's facilities have been moved to a nearby larger site and form a small village of a dozen trailers, a large number of storage sheds, a parking lot for ministry vehicles, an impressive assembly of sampling instruments and a fully equipped weather station.

The trailers are linked to form specialized groups, each designed for a specific purpose.

Two trailers form an effective and up-to-date chemical laboratory equipped with a variety of instruments for the determination of acidity and heavy metal contamination. The instrumentation includes an atomic absorption spectrometer. A 12-litre-per-hour still provides on-site manufactured distilled water available to all research groups.

The limnology group has three trailers, the biology group two trailers, and the toxicity section one large trailer. They are well equipped with incubators to measure the biological production of lakes, equipment for radio-nucleid experiments, facilities for the holding, acclimatization and testing of a wide variety of specimen and for the exposure of various species to various levels of acidification, elevated metal content and other parameters. Space for the preparation of field work is also provided. Three additional trailers house offices, lunch areas and toilets.

The new laboratory village has a population of 20 resident scientists and technicians. Facilities are also available for visiting research groups and for the equipment they need for their special projects.

The new equipment and expanded facilities give the Dorset laboratory the ability to test samples on-site with a 10-fold increased precision and reliability. This applies especially to perishable samples that have suffered in the past during their transport to the ministry's main Toronto laboratory.

The new laboratory will also permit the inclusion of several new study projects into the ministry's acid rain study program. Among these are studies on stream biology, on the effects of increased acidity, on deep-layer organism, on aluminum chemistry and on the chemistry of snow.

one of the 34 acid rain monitoring sites established throughout the province.

The new, enlarged Dorset laboratory consists of a dozen large trailers housing a variety of laboratories, facilities for employees and storage areas for equipment. On the right: the interior of one of the two chemical laboratories provided for the on-site analysis of water samples.

(photos: Robert Koci)

## Testing for contaminants

# A rainbow under the microscope

**by Robert Koci**

During the ten years of Environment Ontario's activity, the fight against the pollution of our environment has undergone significant changes. In the early '70s most of the symptoms of the degradation of our environment could be clearly seen — as dark clouds of smoke issuing from factory stacks or discolored waters carrying wastes that could often be seen and smelled.

Today visible symptoms of pollution have become very rare. The white clouds that can be observed issuing from factory and power plant stakcs consists most often of clean water vapour. The emissions of acid rain causing sulphur dioxide are invisible. Effluents discharged from sewage treatment plants and industrial operations are often cleaner than the waters they are discharged into.

### *concern focuses on invisible pollutants*

Our concern for a clean environment and the efforts of scientists, engineers and law-makers are now concentrated on the control of pollutants invisible to our eyes and non-detectable by our senses. Their presence can be revealed generally only by highly sophisticated instruments operated by people who know how to look deep into the mysterious world of molecular and atomic structures.

Today the presence of pollutants — residual pesticides, industrial organics, potentially carcinogenic and mutagenic chemicals, heavy metals and others is measured in parts per million (ppm), parts per billion (ppb) and parts per trillion (ppt).

The actual meaning of these yardsticks defies human imagination.

It may be made easier to understand by a comparison:

- the duration of one second, compared to the duration of 13 days is one ppm;
- the duration of one second compared to 33 years is one ppb;
- the duration of one second compared to 33,000 years is one ppt;

Measured in such detail, no material found in nature is pure. Even the "purest" spring water of a brook bubbling along in a forest untouched by man, if tested with such yardsticks, contains numerous minerals, organic materials and bacteria.

There is hardly any natural or man made material that could not be detected in air or water if it were looked for at the parts per trillion level.

This fact must be considered when samples are being taken and when these samples are analyzed for various contaminants in today's sophisticated laboratories. Practically anything can be found in any sample at these minute levels.

To be valid, a chemical analysis must be reliable and repeatable. To assure such reliability and repeatability, the analytic procedure to be applied for various materials or groups of materials has been established in great detail and is described in test protocols. The test protocol for the determination of halides — compounds containing chlorine, bromine and iodine — for example, or the protocol for the determination of the presence of mutagens in a sample each fill about 12 typewritten pages. The protocols go into such minute details as the description of the materials and temperatures that must be used to wash, rinse and dry sampling bottles.

The extraordinary care required to keep samples free of contamination starts with the provision of the sampling containers. About a dozen various bottles made of various materials are available to the technician entrusted with the sampling. Each bottle is designed for a specific and unique analytical purpose — the collection of samples for bacteria counts, for the determination of heavy metal content, of organics, of halides, of volatile substances, etc.

### *sampling bottles need special care*

Bottles for samples for metal determination may be made of specially cleaned plastic, but cannot have metal caps or liners, and bottles for the sampling for organics must be made of specially clean glass and cannot have plastic caps. Their use would show, for example, the presence of phenols and other components of the cap material in the liquid to be tested.

Other bottles must be made of colored glass to protect the contents from light. All must be handled and packaged with special care — the price for individual 1-litre bottles made from contaminant-free flint glass may range up to \$4. each. The additional cost of the handling and packaging of such bottles may range up to \$6. each (and there is no refund for empties).

During sampling, the technician must avoid all contact with the sample — if the water to be tested flows over his fingers before it gets into the bottle, the sample is useless. Similarly, funnels are taboo. The plastic or metal of the funnel would distort the results of the analysis.

Bottles must be filled to the brim to prevent as much as possible contact of the sample with the air entrapped in the bottle. The label on each bottle must carry information as to where, when and by whom the sample was collected, whether preservatives were added, which ones, and other data that may be of value to the laboratory.

For the determination of the type and amounts of contaminants possibly present in a sample, a number of techniques and many variations of these techniques can be used. At the Environment Ontario laboratory, nine principal methods are available:

*for most analyses spectroscopy is used*

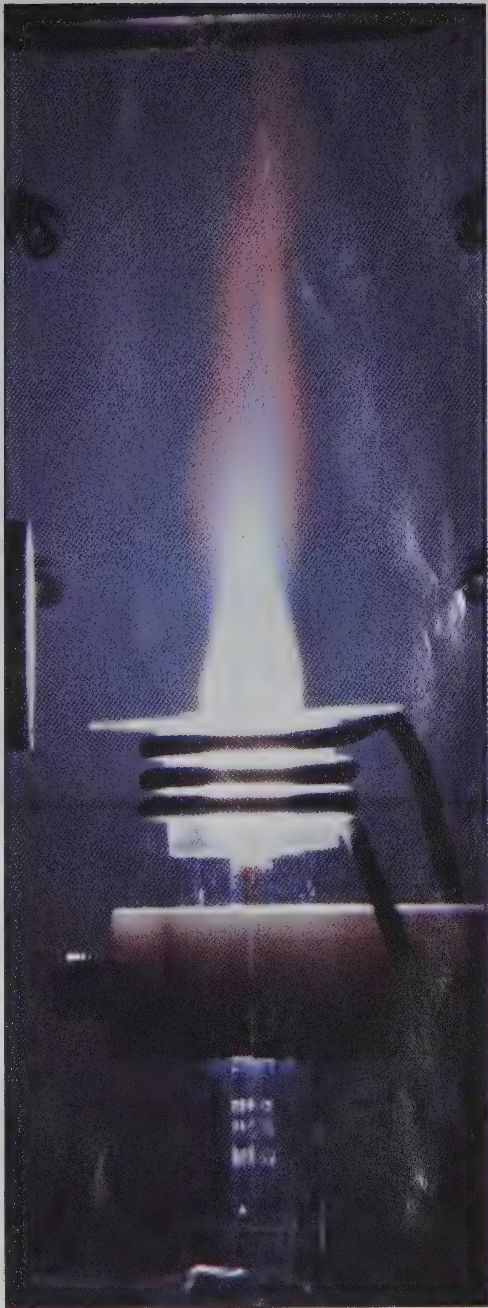
- electroanalytical analysis
- X-ray fluorescense spectroscopy
- spectrophotometric techniques (ultra-violet, and infra-red)
- atomic emission spectrometry
- atomic absorption spectrometry
- liquid chromatography
- flameless atomic absorption spectroscopy
- gas chromatography
- mass spectrometry

Some of the methods are suited for the determination of organics, others for the determination of metals or other contaminants. For most analyses for pollutants several methods are used in parallel to gather information on every possible aspect of the sample. In some cases, several methods will be used to determine one parameter. The data gained are then compared and accepted only if there is a valid correlation among them. If no correlation is found, the whole process of sampling and analysis is repeated.

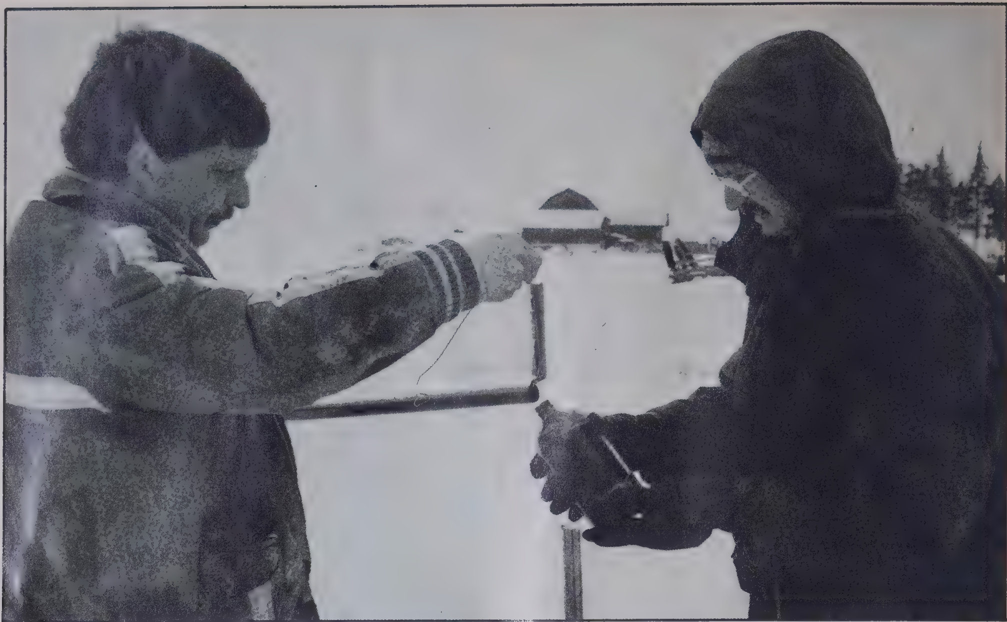
Many of the methods are based on forms of spectroscopy. This method depends on the fact that atoms and molecules, under the right conditions, can absorb or emit light at a specific wavelength. Each atom and each molecule of a compound absorbs or emits energy at a unique, specific wavelength.

To achieve the right conditions, atoms and molecules of the material in the sample are "exited" by electric resistance heating to temperatures of up to 2000° C or in an argon plasma. This is a field of pure energy in which temperatures reach double the temperature of the surface of the sun — 11,000° C.

The light emitted by the material is split by a prism — or a grating — into its spectrum — which is much like a rainbow. Under a microphotometer (a form of microscope) or other light measuring device, the rainbow



**The white bottom part of the "flame" is not a flame but a field of pure energy created in an argon-plasma. The colored part consists of light emitted by the excited atoms of a metal.**



**Environment Ontario technicians Derek Smith and Allan Van Norman retrieve a sample from an about 40 meters (116 ft.) deep sampling well on a landfill site. Properly done, it may take an hour to sample a well.**

then reveals the individual "fingerprints" of the material.

This "fingerprint" is compared with "fingerprints" kept on record in a computer memory. Although each fingerprint is very individual, the characteristics of some of them overlap — one example of such an overlap are the spectral images of some salts and of arsenic. When arsenic is tested for in a sample, the testing protocol demands an extra step in the sequence to separate the readings caused by salt from those caused by arsenic.

The comparison of the "fingerprints" is done electronically and the data are manipulated by computer, which then provides a detailed print-out that also shows the amount of the contaminant present in the sample.

## *testing water is triple distilled*

The use of spectroscopy to determine contaminants sounds very simple — it is, however, complicated by the necessity to eliminate all possible errors. To eliminate such errors and to avoid misreadings, up to 20 control tests are made for every batch of actual samples tested. In these tests, first "blanks" — samples of pure water — are sent through the testing cycle.

As no pure water can be found in nature, the laboratory provides its own — by the double and triple distillation of tap water under strictly supervised conditions. At Environment Ontario's lab, the distilled water produced is tested daily. It is used not only as a "pure sample", but also to wash between every step in the testing sequence the containers and the piping of the automated machinery used.

In addition, blanks spiked with precise amounts of the suspected contaminants are sent through the spectroscopic cycle. The technicians operating the spectroscope know how much of which contaminant has been added to the blank, and will proceed with analysis of the actual sample only if the computer printout shows the expected results. The materials used in spikes are primary standards of certified purity and are very expensive. Results are also checked by analyzing reference materials, which are purchased from official sources in the U.S. and Canada, and whose contents have been determined and certified by a number of trusted laboratories.

Eventually the sample itself is analyzed. Sometimes a certain amount of the suspected material is added to a duplicate portion to achieve a better indicator of contaminant recovery. The real contamination is then determined by simple arithmetic.

A number of materials used in everyday life are strictly kept out of laboratories involved in the search for contaminants — normal paper issues, like Kleenex, for example. They may be clean to the eye, but generally contain variable amounts of materials that may be considered under some circumstances as contaminants — mercury, for example, titanium, and other additives used in the paper industry.

In the laboratory itself the chemical composition of everything — from bench tops to light fixtures — has been

analyzed and this analysis must be taken into account when samples are put through the process.

Despite all the precautions, the analysis of minute quantities of materials is sometimes fraught with mysteries. When Environment Ontario laboratory scientists started to analyze the metal content of fish, for example, they were puzzled by the repeated appearance of iron, chromium and nickel atoms in their spectra — always in exactly the same ratios. The ratios remained constant regardless of the species, age and habitat of the fish.

It took some detective work to discover that what the instruments were measuring was the presence of stainless steel in the fish samples — stainless steel from a rotary knife used to mash the fish flesh before it was rendered suitable for spectroscopic analysis.

In another case, zinc kept turning up in spiked blanks. All action had to be stopped until it was found that the contamination derived from the nozzle of a syringe-like instrument used to inject minimal amounts of known material (spikes) into pure water blanks. Zinc is used as a stabilizer in the plastics industry, and enough was being carried through during spiking to cause a problem.

## *atoms of material wander through space*

In their search for contaminants in the ppb and ppt range, the scientists also have to cope with the atomic and molecular structure of matter in general. At this level, even the most solid-appearing material consists of a great amount of empty space tied together by a lattice of electrons and protons. The structure is in some ways comparable to the structure of our universe, in which dots of light — suns — are tied together by the force of gravitation acting over vast areas of empty space.

Atoms of material easily wander throughout this lattice. This means, that atoms of metals may, for example, drift into the lattice of molecules that make up the glass of the sampling bottle. Conversely, atoms of metals held in the glass of the bottle will drift into the sample, despite all precautions.

The instruments used to measure minute quantities of contaminants can actually detect and show this movement on their screens or on the computer printout and the final results of the analysis must be corrected accordingly.

In some cases, the limits of detectability are not dictated by the ability of the instruments, but by the quality of the air in the laboratory. The cleanliness of the air is measured by the air's contents of particles.

The air in Environment Ontario's main laboratory's pressurized clean room checks out at 10 micrograms of particles per cubic meter. This is the best that can be achieved without resort to extraordinary measures, as distilled water showers, dust-free gowns that completely enclose the person working in the area, and other similar measures.

The extraordinary care that must be taken all along the way from sampling to analysis and to the final cross-check

**In some analytical procedures a great volume of samples is needed and in other cases the pollutants suspected in the sample are volatile and must be preserved by preliminary steps that can be taken in the ministry's mobile laboratory. In the mobile laboratory, Louis Au of the ministry's pesticide section passes large amounts of well samples through a resin column that will adsorb suspected mutagens for later analysis in the main laboratory.** (photo: Robert Koci)

of the results is reflected in the cost of the procedures. The cost of the analysis of a single sample for dioxin at ppt, for example, is estimated at $900. This amount does not include the costs of sampling, which may even run higher in remote areas and under special circumstances, such as spring thaw.

In some projects as, for example the fish testing program, Environment Ontario scientists have developed unique assembly-line procedures that allow the processing of many samples in a short time at a low cost. Even under such circumstances, however, the reliability and validity of the results is fully guaranteed.

## A history of sewage treatment in Ontario

# From privy to full treatment

by **Ann Marshall**

Once upon a time, when about 220,000 Indians lived in this vast country stretching from the Atlantic to the Pacific, the human wastes produced by the roving tribes were easily absorbed by nature. The environment was left unspoiled and Ontario's waters clear.

The first settlers in Canada and in Ontario were farmers. They also had few problems with the disposal of sewage.

The situation changed when towns and cities started to grow at the turn of the century.

During the 19th century, medical science had become aware of bacteria as the cause of diseases and of the connection existing between the disposal of sewage and the spread of diseases caused by waterborne bacteria, such as typhoid fever.

This awareness and the frequent incidence of typhoid fever in Ontario communities provided the first impetus for measures that would protect man and the environment and, eventually, for the development of sewage and water treatment systems.

In the 20th century, the typhoid problem was solved, but the continuing rapid growth of large centres of population and the spread of industrialization during and after World War I and, especially, World War II, created new pollution problems and presented new challenges.

* * *

In the late 1800s most localities took drinking water from wells and disposed of slops and waste in privies. These privies were emptied from time to time and their contents, "night soil", were used as manure or left to decompose in more or less suitable places. Cesspools or septic tanks, in which waste could decompose by the action of bacteria, were used rarely.

In large communities, properly constructed and connected sewers were considered to be the best means for the disposal of sewage, but municipalities did not always use the system best suited to their circumstances. Drains and sewers were often improperly built; closets and cesspools were connected to drains unfit to receive and to carry away the contents.

Drains opened into houses and sewage gases were not properly ventilated. Many sewers were not laid to proper grade and had to be flushed. Many sewers were, in fact, underground cesspools.

In the water-carriage sewer system, generally established in densely populated areas, sewers were laid at a proper grade to allow quick passage of waste. A sufficient amount of water had to be provided to carry the waste to the sewer outfall. Effluents were generally discharged into water courses, and the only treatment generally used was simple dilution. Other treatment methods were known at the time, but were rarely used in Ontario because they were either of dubious effectiveness or too costly.

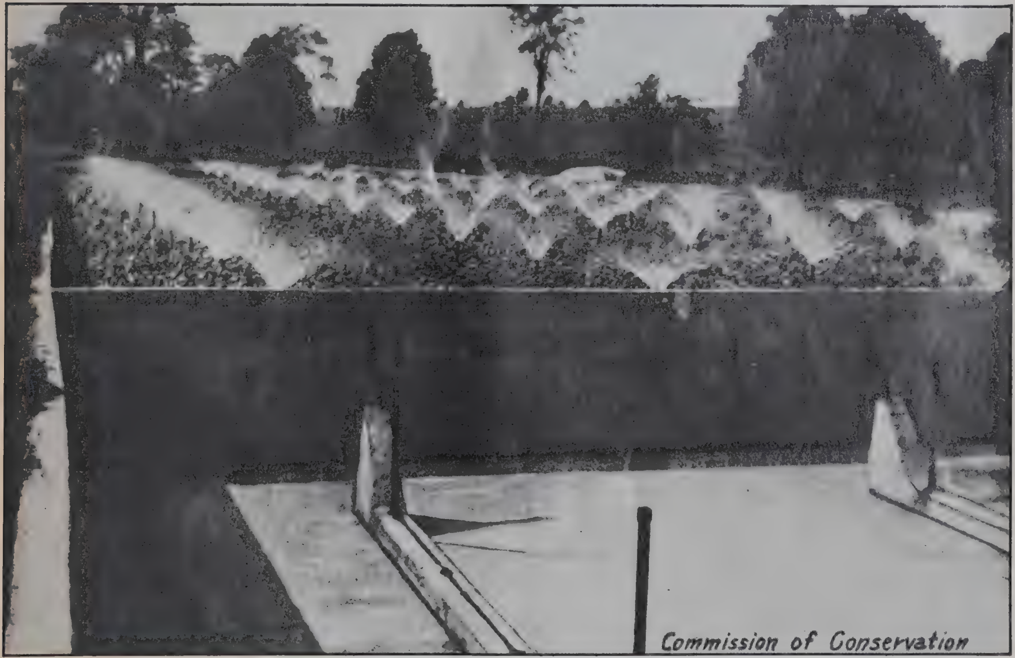
In 1896 a chemical purification treatment system was tried for the first time in Hamilton, but was soon abandoned.

In 1882 the Provincial Health Board was formed in Ontario to advise local health boards. One of the major concerns of the board was typhoid fever. Eighteen persons out of 1,000 suffered from typhoid or similar diseases, and the average mortality rate was much higher than the one statistics registered in European cities.

To institute some means of control, the board gathered information from the United States and from Britain. Britain was, at the time, the leader in the development of sewage disposal methods.

The experiences gained in Europe showed that treatment of municipal water supplies and treatment of sewage wastes could reduce the incidence of typhoid fever. In Frankfurt, Germany, the death rate of typhoid

**One of the mains of the 480-miles-long Toronto sewage system serving a population of 500,000 in 1915.**




**In many municipalities sewage treatment consisted of sprinkling-filter systems, in which raw sewage was sprinkled onto a bed of rock. Bacteria covering the rock provided aerobic treatment.**

was 8.5 per 10,000 inhabitants in 1856. On completion of a good sewage system, the death rate dropped to 2 per 10,000 inhabitants.

In Ontario, sewage treatment consisted mainly of a dilution of the effluent from the outflow pipes. Aerobic bacteria were expected to decompose the organic matter in the sewage as it travelled downstream.

Unfortunately, sewage outfalls often emptied into the same body of water from which drinking water was taken. In Sarnia, for example, sewage outfall and drinking water intake were only 150 feet apart.

In Toronto the first sewer system was built in 1840, and its content was discharged untreated into Ashbridge's Bay. The bay became unsightly and a danger to public health. The solution applied to such a problem at the time was to move the sewage outfall elsewhere.

From 1880 on, sewage systems were built to a greater extent in the large communities. By 1891, they consisted generally of small-gauge sewers that excluded all storm and rainwater. They were constructed to be easily inspected and cleaned.

## *strong opposition from municipalities*

Although this system carried a concentrated form of sewage it was considered at the time to be the most sanitary and economical. The main problem of sewage disposal was what to do with the effluent from the sewer.

By 1901 Ontario's population had grown to 2.2 million. Sewage treatment had become more important than ever before, but its introduction ran into strong opposition. Municipalities situated on the shores of the Great Lakes balked at the costs they were expected to incur and refused to treat their sewage until communities on the U.S. shores decided to treat their own.

During the first decades of this century a number of sewage treatment methods were available to municipalities:

— Imhoff tanks and filters were used to a minor degree.

— One fine-screening plant was used in Sudbury for a short time but proved to be not very effective.

## *sprinkling filters — first bio-treatment*

— Sedimentation tanks were popular. They are still generally used today as primary treatment.

— Septic tanks, and a combination of septic tanks with other forms of treatment such as sprinkling filters, were popular. Sprinkling filters, also called percolation systems, were the first biological treatment systems used extensively in Ontario. One of the first ones was installed in Stratford.

Other plants of this type were built in Brampton in 1906, in Guelph in 1909 and in New Toronto in 1913.

## *activated sludge duplicates nature*

In Stratford, sewage was first passed through screening chambers and a liquifying tank. It was then sprinkled through filters over a bed of crushed rock. The stones were coated with slime which consisted of bacteria which fed on the organic matter in the sewage.

Sprinkling filters were gradually replaced with activated sludge plants which have a greater treatment capacity. They can remove up to 95 per cent of the contaminants against an 80 per cent removal in sprinkling filters.

The activated sludge system duplicates and accelerates nature's waste treatment process. In it air is entrained into the sewage flow. The oxygen content of the entrained air provides a good environment for aerobic bacteria and enhances their ability to decompose sewage.

True activated sludge plants did not come into use in Ontario until the mid-'20s.

In 1928 Ontario experienced more building activity than in any year since 1913. By 1929 there were 95 municipal sewage systems in operation in Ontario, serving 1,800,000 people. Forty-six systems were equipped with treatment plants; 16 of these plants used sedimentation tanks, nine Imhoff tanks and filters and 19 were activated sludge plants. Plant effluent was not chlorinated.

## *typhus control by chlorination*

From 1903 to 1913 the typhoid death rate was 24.4 per 100,000 people in Ontario. In Europe the rate was considerably lower at 8/100,000.

Typhoid was scattered throughout the province. Ottawa suffered two major outbreaks between 1910 and 1913.

One in 10 persons that contracted the fever died.

To stop the spread of the virulent disease, the Ontario Board of Health was given the responsibility to approve all sewers and watermains.

Dr. Albert E. Berry, who joined the Board of Health in 1920, recognized that the incidence of typhoid could only be controlled by the introduction of chlorination of effluent and of water, and by the pasteurization of milk. As director of the division of sanitary engineering, Dr. Berry worked diligently from 1926 on to promote the use of chlorine. He was also responsible for the introduction of the compulsory pasteurization of milk.

By his initiative, Ontario became one of the first jurisdictions in the world to apply chlorination and pasteurization against much resistance, mainly from dairies which feared an alteration of the taste of milk by the process.

To gather firsthand information, then Ontario Premier Mitchel Hepburn toured the typhoid ward of the Hospital for Sick Children in Toronto. One visit was enough to persuade him of the need of compulsory pasteurization. Dr. Berry was given the assignment to provide the suitable legislation and to enforce it.

An important tool in the battle against typhoid fever was the development of the biochemical oxygen demand (BOD) test in the 1920s.

## *excessive oxygen demand by industrial waste*

Another important step in the control of pollution of Ontario waters was the formation of the International Joint Commission in January, 1909, by an agreement between Canada and the U.S. In the agreement, both countries promised to co-operate to protect their boundary water, principally the Great Lakes, from pollution.

The first major action of the new commission was the completion of a study designed to determine the extent of pollution in boundary waters. As pollution indicator, the incidence of coliform bacteria was used.

The study, completed in 1912, showed that the water in certain areas of the Great Lakes was dangerously polluted, and that all municipal water supplies taken from the Great Lakes were unsafe if the water was not treated. In the few municipalities that supplied treated water, the treatment was minimal.

Every municipality on the shores of the Great Lakes discharged untreated sewage into the lakes, and the typhoid rate in these municipalities was the highest in Ontario and in the U.S.

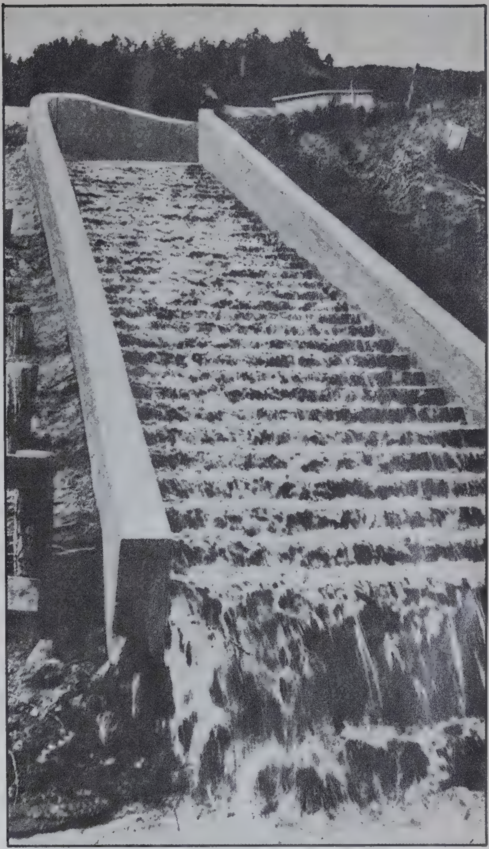
The report of the IJC recommended a daily bacteriological examination of drinking water, the treatment of all water supplies and the installation of proper sewage treatment.

After a good start in the 20s, the construction of sewage treatment systems decreased in the years 1930 to 1955.

## *recommended treatment: sedimentation, disinfection*

During the depression years, the limited funds available to municipalities were generally used to alleviate social problems.

The depression years were followed by World War II which imposed a different set of priorities together with the lack of materials and manpower for non-military uses.



**Some aeration was provided by running untreated sewage over steps at the sewer system outfall.**

The war years were followed by the postwar slump, which lasted till about 1955. In this time materials were still scarce and an escalation of prices prevented municipalities from building new sewage treatment facilities or from improving the old ones, strained as they were by the growth of population in large centres and the development of industries.

As the growth of cities and of industrial development continued, sewage purification works were overloaded not only by sewage inflow but also by liquid industrial wastes dumped into the system.

To support municipal sewage and water treatment projects, the Municipal Act, as amended in 1943, allowed municipalities to finance such projects by a user rate rather than from taxes. In 1950 the Municipal Improvement Corporation was established to help municipalities to borrow money for sanitary works at low interest rates.

Despite all the difficulties, some progress was made. At the end of 1930, 25 of 70 sewage disposal plants provided activated sludge treatment. By 1936, although dilution was still the most frequent used method, 26 plants had

# Environmental pioneers

## Willis Chipman
## Dr. Edward Berry

by Tom Davey

*For water resources, no country on earth is as fortunate as Canada and no province can match Ontario in the size and diversity of its waters.*

*But Ontario is doubly fortunate: it has bred two understanding sons who were not only pioneer engineers, but environmentalists decades ahead of their time.*

*One of them was Willis Chipman, who was truly a giant in Canada's environmental development. Born in Elgin, Ontario, in 1855, he graduated from McGill University with top honors in civil and mechanical engineering. In 1881, he obtained both dominion and Ontario land surveying commissions. Many land surveyors of those days had interests in hydraulics and other engineering disciplines.*

*From 1890 on, Mr. Chipman's record in the design of sewage systems and water treatment plants was remarkable. The Gore & Storrie publication "A Perspective on the Development of Consulting Engineering in Canada" names him as the originator of the separate system for sanitary and water sewers in Canada.*

*In 1901, he formed a consulting partnership with George H. Power. The firm was responsible for the design of many of Ontario's first sewage systems with over 50 projects or reports on record from Halifax to Victoria. Mr. Chipman's designs were based on the experience he gained studying water works and sewage problems in the U.S., Scotland and England.*

*He was a prominent member of the Engineering Institute of Canada and was most active in the creation of the Association of Professional Engineers of Ontario.*

*Willis Chipman died on January 3, 1929, and was buried at Brockville.*

*As the Chipman era faded, the career of another dynamic Ontario engineer had started to change the course of the province's environmental destiny.*

*Albert Edward Berry, was born in St. Mary's, Ontario, in 1895. He gained a B.A.Sc. from the University of Toronto, worked briefly for the Ontario Board of Health, then went to England as a second lieutenant in the Royal Engineers during World War I.*

*Britain was then a pioneer in sanitary engineering and Lieutenant Berry found much to intrigue him. The discovery of the activated sludge process in Britain still remains the single most important event in waste water treatment.*

*After the war, Dr. Berry returned to the Ontario Department of Health and took a master's degree with a thesis on refuse collection and disposal. He agrees*

activated sludge treatment, nine had sprinkling filters, 33 sedimentation tanks and two had fine screening facilities.

In 1943, 70 per cent of the population of cities enjoyed sewage treatment. In 1955, 10 new sewage treatment plants were put into operation, for a total of 54 activated sludge, 19 sprinkling filters and 129 primary treatment (principally sedimentation) plants.

By 1950 the typhoid death rate had decreased to 0.02 per 100,000.

From 1946 to 1949 the IJC conducted another study of Great Lakes water quality. At the time, 96 per cent of the population of the area had sewers and 86 per cent had primary treatment of wastes. Only a small percentage of communities were served by secondary or activated sludge treatment. Despite the increased number of plants

## control of pollution in the Great Lakes

providing primary treatment, the concentration of bacteria in some of the Great Lakes waters was three to four times greater than the concentrations detected in 1912.

At the time of the 1912 study, industrial wastes were of little concern. During the following decades, however, industry spread tremendously. At the time of the 1946-1949 study, the oxygen demand of industrial wastes was equal to the BOD of the untreated sanitary wastes that could be expected from a population of 4 million people.

In fact, industrial wastes placed a greater demand on the receiving waters than the combined total sewage produced by the study area population of 3.5 million.

The study recommended the treatment of all municipal wastes by sedimentation and disinfection, the introduction of more efficient secondary sewage treatment and the treatment of industrial waste.

In 1956 Ontario established its Ontario Water Resources Commission as the first organization of its type in the world. The commission's mandate was to build, finance and operate sewage disposal and water treatment facilities in the province.

There were many reasons for the establishment of the OWRC.

Until World War II, water was taken for granted in Ontario. The war, industrial boom, increase in population, and increase in capital costs and interest rates made it difficult for municipalities to meet a suddenly increased demand for services. In some areas water was in short supply. Increased pollution required costly additional treatment.

Practically all municipalities were required to build secondary treatment works unless situated on large bodies of water. In the mid-1950s, Ontario's water situation was deplorable and some authority was needed to bring order to the situation.

It was Premier Leslie Frost who was directly responsible for setting up the OWRC. At an informal

gathering in 1953, President Dwight Eisenhower of the U.S. challenged him, "Mr. Frost, you people here have a great country with great possibilities so don't let them ruin your water ... You really should remember that pure water is one of your greatest assets. But when you've got it, you don't think about it."

This statement provided the impetus to Mr. Frost to form the OWRC.

Following the passage of Bill 98, a ruling body of five members of the commission was appointed: A.M. Snider, J.A. Vance, W.D. Conklin, R. Simpson and W.H.C. Brien. At the first meeting, on May 17, 1956, Dr. Berry, "one of the foremost authorities in North America, probably in the world" was appointed general manager and chief engineer. Brian Larmour was appointed secretary.

The former Act of 1956 was replaced by the Ontario Water Resources Commission Act, 1957. It came into effect on April 3, 1957.

During the OWRC's years of service, much progress was made and many sewage treatment facilities were constructed. By 1961, 277 sewage treatment plants were in operation in Ontario.

The commission expanded in size and responsibility: regional offices were opened; training courses for sewage and waterworks plant operators were initiated; and Great Lakes studies were gradually undertaken for the commission's own use rather than for IJC only.

## *OWRC develops financial aid to towns*

The OWRC's first major project was to change Stratford's sprinkling filter to an activated sludge system, and to add sludge digestion. Stratford was forced to do this because adjacent townships had complained that the river was so polluted and devoid of oxygen that it was as black as tar. The plant started operation in 1958.

More financial aids were developed. In 1960, the federal government agreed to assist municipalities by financing two-thirds of the costs of certain portions of sewage treatment works. The funds were administered by Central Mortgage and Housing Corporation.

The commission agreed to finance the remaining one-third and sections of sewage works not covered under the federal plan. By 1965, the capital and operating costs of approved municipal projects could be paid for by OWRC and recovered through service charges to users based on actual usage.

In the late 1960s and early 1970s, phosphorus removal from sewage effluent became a major concern. Phosphorus draining into the water bodies promotes an excessive growth of water plants. The decay of these plants deprives the water of the oxygen necessary for other aquatic life.

*with amused irony that the subject of his thesis, written 65 years ago, is one of our most urgent contemporary problems.*

*When he decided to take a Ph.D. at the University of Toronto's School of Hygiene, he encountered difficulties — engineers weren't supposed to cross disciplinary lines. But Dr. Berry, a very determined man, got his way and gained his Ph.D. with a thesis on the viability of pathogenic organisms in milk.*

*This thesis later helped Dr. Berry to make milk pasteurization compulsory in Ontario. This legislation was the first of its kind in Canada.*

*In 1926, Dr. Berry was appointed director of the Ontario Department of Health's division of sanitary engineering. He investigated a number of epidemics including TB, para-typhoid, and typhoid. Some were caused by contaminated milk, others were caused by waterborne bacteria.*

*In those days, the health department could compel municipalities to chlorinate, or to install water filtration plants. Some of these orders were strongly opposed. In one instance, an entire municipal council resigned rather than obey the order. When the council was replaced, the new councillors again resigned.*

*But they were fighting a man who was to become renowned for his obduracy and the order was eventually obeyed.*

*In 1956 the Ontario Water Resources Commission was formed and Dr. Berry was appointed general manager and chief engineer.*

*While building the OWRC to a world-renowned body, he also found time to devote to professional associations.*

*Under his leadership, the OWRC spurred the construction of water treatment and distribution systems along with effective pollution projects that remain unmatched in Canada.*

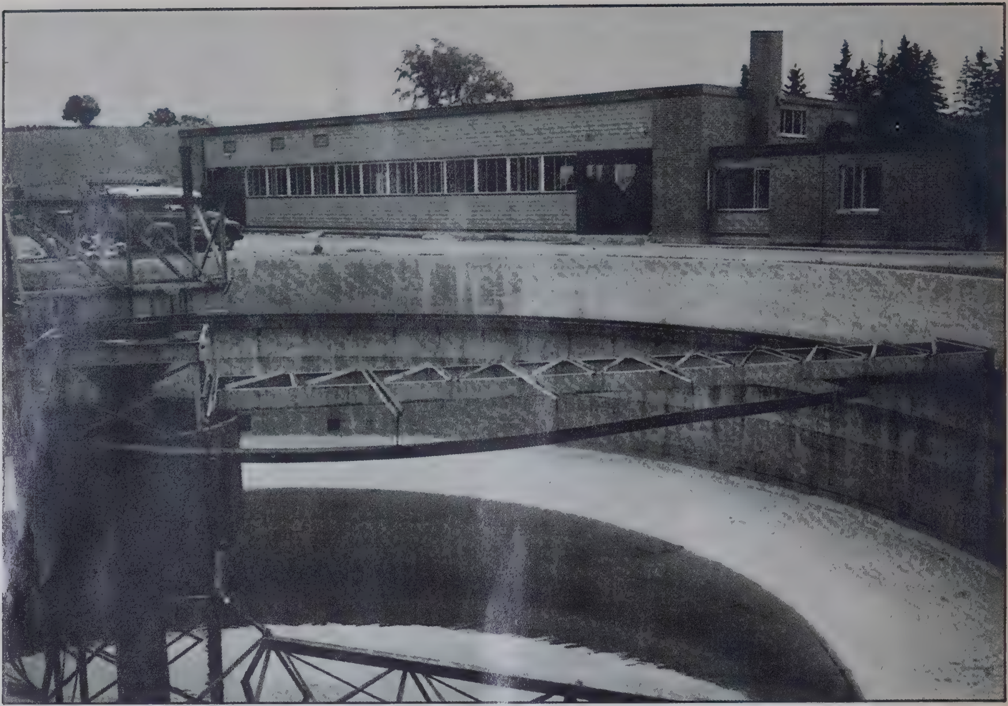
*Officially, Dr. Berry retired in 1963. In reality he kept on working as consultant to the World Health Organization on projects in South East Asia.*

*In 1973, his many achievements were recognized by the award of the Order of Canada. The University of Toronto awarded him the Engineering Alumni Medal. In 1977, his name was placed into the Engineering Alumni Hall of Distinction.*

*In 1981 the Water Pollution Control Federation awarded Dr. Berry the Gordon Maskew Fair Medal for his contribution to engineering training. Dr. Berry, now in his 87th year, is still a legend in the most distinguished environmental and academic circles.*

*But Willis Chipman is almost forgotten. Like Dr. Berry, Willis Chipman was a man of many talents, one being a historical researcher. He was a member of the Ontario Historical Society and made some valuable contributions to its proceedings.*

Mr. Davey is writing a book on the history of pollution control in Ontario. This article is excerpted from drafts of the book.



**The OWRC's first large project was the construction of an activated sludge sewage treatment plant in Stratford. The plant, shown in the photo shortly before completion, went on stream in 1958.**

As a good part of the phosphorus enrichment of Great Lakes waters was provided by the effluent of sewage treatment plants, a province-wide phosphorus and other nutrient control program was established in 1971. The program established 1973 and 1975 as deadlines for phosphorus removal facilities at 210 municipal sewage treatment plants.

On April 1, 1972, the OWRC was integrated into the new Ministry of the Environment which continued with the work initiated by the commission.

## *U.S.-Canada agreement sets objectives*

Under the Canada-Ontario Agreement, the Ministry of the Environment was responsible for the phosphorus removal program. In 1976-77, the provision for phosphorus removal at all significant municipal discharges was completed.

In November, 1978, a new U.S.-Canada agreement set new Great Lakes water quality objectives. They involved tighter controls in the discharge of toxic substances, new phosphorus loading targets and dates for the completion of municipal and industrial pollution abatement programs, and objectives regarding radioactivity.

By 1980, 220 Ontario wastewater treatment plants with phosphorus removal facilities removed 7,000 tonnes of phosphorus yearly from sewage plant effluents.

In the fall of 1980, the first stage of the York-Durham water pollution treatment system, under construction by Environment Ontario since 1975, was officially opened. While the sewage treatment systems in other communities grew piece by piece following the growth of the municipalities, the $300 million York-Durham system is the largest single planned sewage system in Canada. It is designed to serve the present and future needs of the Regional Municipalities of York and Durham with a population expected to grow to 800,000 people.

In 1982 there are 360 publicly owned waste water treatment plants in operation in the province, most of them offering secondary treatment and many of them also providing tertiary treatment or phosphorus removal. They handle together over 1 billion gallons of sewage daily.

Of the total, the province operates 213 facilities, mostly in smaller municipalities that are unable to afford the full cost of adequate treatment. Municipalities operate 147 facilities handling 74 per cent of the total waste water treatment capacity in the province. Communal waste treatment systems now serve 94 per cent of Ontario's urban population or 82 per cent of the total population.

The number of stages of treatment required depend

**The first stage of Ontario's largest pre-planned sewage treatment project, the York-Durham system, includes the Duffin Creek sewage treatment plant opened in 1980. The system will serve a population of 800,000.**

(photo: Tessa Buchan)

upon the nature of the waste to be treated and the effluent quality necessary to adequately protect the environment. Today, methods are constantly being revised and fine-tuned but activated sludge systems are the main treatment methods used. They remove up to 95 per cent of the organic matter and BOD.

Primary treatment or sedimentation removes up to 60 per cent of the organic matter and 35 per cent of the BOD, and a negligible amount of bacteria unless disinfected; this method is allowed where conditions warrant it. Tertiary treatment removes up to 98 per cent of the organic matter and is used generally on small rivers, such as the Don, Grand and Thames. Phosphorus is removed by the addition of chemicals in the last stage of treatment.

Progress has been made over the years but, whereas once domestic sewage was the main concern, we now face new and more complex problems with the discovery of numerous hazardous substances — toxics, heavy metals and oil. Some toxic chemicals are highly persistent and accumulate indefinitely in biological tissues and in the environment.

We impose a great number of intensely conflicting demands on our water resources — health, recreation, fisheries, wildlife, esthetic purposes, navigation, and waste disposal — and we have high expectations for a good quality aquatic environment. Let's hope we stop the trend of continuing misuse and meet this new challenge as we did the old one — typhoid.

# Ontario's water world — in 1992

**by D.N. Jeffs**
**Director Water Resources Branch**

What will our waters be like ten years from now? That will depend very much on changes in our economic and social conditions and on people's reactions to them. Three conditions are particularly significant to the future of water management.

One is largely economic and results from the increasing use of coal to generate electricity in the United States. Burning coal discharges sulphur dioxides, sulphates, nitrous oxides and heavy metals to the air where they can be transported over long distances to be transformed into acid rain. Acid rain can lower the pH of lakes and streams and affect fish, aquatic organisms and wildlife. Improved control measures will be needed to reduce emissions to the atmosphere and protect sensitive land and water resources.

In contrast, in Ontario we find increasing use of nuclear power for electrical generation. Its main effects on water resources are physical damage to some aquatic life at water intakes and elevated temperatures of the discharged cooling waters. Increasing attention is being given to the design of intake and discharge facilities to protect fish habitats and reduce effects on aquatic life.

The second condition is both economic and social, and is also tied to the increasing cost of fuel. It is the likelihood that people will spend more of their recreation time closer to home. This may lead to demands for continuing improvements in the quality of water for recreational uses including swimming and fishing, especially close to urban areas where it is most difficult to achieve high level of water quality.

The third condition is largely social. It is the increasing public awareness and concern about trace contaminants which may be harmful to aquatic life or man. This awareness results in a growing demand to reduce and eliminate discharges of hazardous contaminants to the environment.

With widespread support for better water quality, we can look forward to improvements in waste-water treatment processes at industries to reduce the discharge of trace contaminants to the environment. Some of these improvements will be at plants with their own full treatment systems. Other plants will provide better pre-treatment of their wastes before discharging them to municipal sewage systems or to the yet to be established liquid industrial waste treatment facilities.

*public awareness will lead to action*

Contaminants such as pesticides, metals and airborne organic chemicals also reach watercourses from many diffuse sources including runoff from urban and rural areas. Such sources are hard to control. In many cases, improvements will arise from changes in emissions; for example, the switch to unleaded gas and restrictions on the use of some pesticides or chemicals such as DDT and PCBs. In others, public awareness that releasing waste oils or cleaning solvents to storm sewers pollutes our waterways will lead to actions to correct such practices.

Hand in hand with these changes will go requirements for analyses of a wide range of compounds in effluents, receiving waters, streams and lakes. This information will be produced by sophisticated laboratory equipment and skilled scientists and technicians. Then it will be stored and processed in the Ministry of the Environment's industrial monitoring information system and sample information system.,

Results of the monitoring programs are evaluated by other ministry scientists and engineers and published for use by the public and those who plan and manage water resources.

The ministry will continue its program to provide to the public information on contaminants in sport fish as a guide to consumption and to the conditions of our lakes and rivers. This information gives a broad understanding of contaminants and their significance and identifies changes in their levels.

Turning to ground water, we note an increase in recognition of the need to protect this valuable portion of our water resources. Ground water is the source of supply for most rural residents and for

many of our inland towns and cities. The quality of this water supply has been threatened in the past primarily by waste disposal sites. Today all waste disposal sites have been reviewed by the ministry and where conditions were unsatisfactory, sites have been closed or operating requirements changed.

Proposed new sites receive detailed reviews to ensure sound design and operation to protect the quality of ground water and surface water. The efforts of the Ontario Waste Management Corporation to build a modern plant for the treatment and disposal of liquid industrial wastes will remove a number of contaminants from the environment and provide still more protection for our water resources.

A good example of the progress possible once a problem has been recognized, the causes determined, and remedial actions accepted is the case of past nutrient enrichment and excessive algae growth in the Great Lakes.

On the recommendations of the International Joint Commission, agreements on Great Lakes water quality were signed between Canada and the United States and between Canada and Ontario calling for a reduction of phosphorus discharges from sewage treatment plants in the Great Lakes basin. Ontario municipalities with support from the federal government

## phosphorus reduction shows good results

soon added chemical treatment to their sewage treatment plants to achieve the objective of one milligram of phosphorus per litre in their effluent. Together with reductions of phosphorus in household detergents, this action has markedly decreased the discharge of phosphorus to the Great Lakes and has reduced the amount of algae at many locations along the lakes' shorelines.

As as consequence, treatment of drinking water at several municipal plants, where algae were previously a problem, became easier and beaches became more enjoyable.

Extensive studies were also conducted on pollution from runoff from agriculture, forestry, industrial and urban land areas. Reports

## land use planning will also protect water

published by the IJC and jointly by Environment Canada and Environment Ontario deal with means of reducing pollution from these diffuse sources.

Planning decisions on land use and design requirements can aid in protecting water quality and maintaining adequate ground water supplies. The ministry's water quality and streamflow networks, its water-well record system, and its basin inventory and management studies provide the information needed for sound planning and management decisions. The mutual interest among farm groups, conservation authorities and government agencies will lead to increased efforts to control erosion in the '80s. Such control will provide benefits from better soil tilth, the protection of fish habitats and less loss of nutrients from farmlands to streams and lakes.

In 1978, a revised Great Lakes Water Quality Agreement between Canada and the United States placed more emphasis on the need to deal comprehensively with hazardous contaminants and to reduce inputs to the Great Lakes. This will allow us to look forward to further important improvements in water quality in the next ten years. As in the past ten years, improvements will be achieved by mutual action and will be broad in scope.

## improvements depend on co-operation

Many of the improvements we expect are continuations of changes commenced in the '70s. They include further reductions in levels of nutrients and hazardous contaminants, and better water quality for recreation near urban areas.

Improvements related to acid rain will take longer. They may only begin to be effective toward the end of the decade. Action must be taken in both the United States and Canada to reduce emissions of sulphur and nitrogen oxides to the atmosphere.

Major reductions are needed to protect sensitive lakes and drainage basins in both countries. Negotiations will be hard. Industries and power generating stations face large equipment and operating costs to reduce emissions, and abatement at source will only be achieved over a period of years. Then, the effects of high acid levels in our lakes and streams, particularly during the spring runoff period, will start to ease.

Acid rain and hazardous contaminants each pose highly complex problems. To understand them and bring effective control measures into play places high demands on scientists, engineers and managers of governments, industries, universities and consultants.

Gathering information on source, pathways, reactions and effects, they will have to reach conclusions and recommendations for control of different contaminants based on their scientific and engineering knowledge and expertise. All need the support and advice of a well-informed public.

The answers to environmental concerns will not be easy, but the ministry will provide information, expertise and dedication to ensure continuing improvements in water quality in the 1980s.

# Towards new ways of management

**by Donald A. Chant**

**Chairman and President**
**Ontario Waste Management Corporation**

The Ontario Waste Management Corporation created to build and manage a province-wide system for treating and disposing of liquid industrial and hazardous waste, has recently embarked on a facilities development program, following the rejection of the proposed South Cayuga site in November, 1981.

Before outlining the key components of that program, let us look briefly at the nature of the problem we are trying to solve. Clearly, it is an urgent and serious one. The liquid industrial and hazardous wastes we must treat and dispose of are numerous and in some cases are highly toxic.

We have seen estimates of 60 to 70 million gallons of this material generated every year in Ontario, and about 3 per cent, or two million gallons, can be regarded as toxic or hazardous. This estimate accounts only for the wastes licensed to be transported on public highways, and does not take into account the wastes that are stored, disposed of on the generator's premises, recycled, or simply taken out to the 'back 40' and dumped.

There are currently 8 licensed landfill sites in Ontario receiving this material. Prior to provincial waste management laws enacted in 1971, there were hundreds of such sites. In 1979, Environment Ontario found approximately 800 abandoned and uncovered dumps in Southern Ontario alone. Few of them are likely to contain highly toxic material, but it is clear that we have environmental time bombs sitting around the province.

At the time these wastes were dumped we knew far less about the consequences of inadequate waste disposal. We didn't know then that something as useful as PCBs — they're one of the best insulators known to man — could wreak such havoc on biological life.

Today, a larger portion of our industrial wastes consists of oily water and inert sludges, which are not so much hazardous as troublesome. The rest of them, though, read like a recipe for a witches brew — cyanides, phenols, glycols, amines, acids, alkalis, organic solvents, plastic resins, pigments, plant and animal wastes, detergents, chlorinated hydrocarbons, insecticides, pesticides, pharmaceuticals, cosmetics and PCBs. There are literally hundreds of categories occurring alone or in combination.

These wastes are generated in the normal production of the goods that we buy and use every day — the paper we write on, the ink we write with, plastic pens, the steel and the vinyl and the rubber in our cars, the petroleum products to run and lubricate them, the dyes used to color our textiles.

I do not believe we can blame industry alone for the waste problem. In fact, there are no guilty parties. We all buy and need the goods and services industry produces and we all must share the responsibility for disposing of the wastes that are created as a result.

The problem, then, is a serious one, shared by us all. While there is obviously an urgent need to put in place treatment and disposal facilities as quickly as possible, we must not be panicked by the situation. Building on marginal sites is not our business. We intend to do it right.

To do it right, we must develop and implement a province-wide long-term program, aimed at not only treating and storing wastes, but also at reducing and recycling them. We can expect little sympathy and support in locating and building waste treatment facilities if we do not also develop programs for assisting industry in reducing and recycling as much waste as possible.

A provincial waste treatment and storage system remains, however, a top priority. But before we invest the millions of dollars involved, we must have an accurate picture of the wastes generated in the province.

Environment Ontario's waybill system is one source of information. In addition, our consulting engineers, Proctor & Redfern, are conducting a five-month waste quantity study, involving discussions with industrial associations and waste generators. This will show us the size and the scope of the problem and allow a projection to the year 2000.

Another study is being conducted by the same engineering firm to identify the most desirable and most effective technologies available to treat these wastes.

This study will look at treatment processes that are used in Europe, Japan and throughout North America to reduce wastes at the plant, recycle wastes within the plant or at a central location, and treat wastes prior to entombment in a secure landfill. About 100 different technologies are available for destroying or converting wastes into less toxic and troublesome forms and we want to ensure that our facilities contain proven, world-class technology.

But perhaps the most sensitive and controversial issue involves the actual location of one or more treatment facilities in the province. How do we intend to locate these facilities?

**In some large industrial operations, liquid waste is treated at the plant.**

There are a number of basic principles to guide us in this process.

— The site or sites we select for development must contain natural, predictable features, which minimize the need for major corrective engineering, and which provide us with enough advance warning of any problems that might develop. The site also must give us several decades of use.

— A secure landfill must be located in clay soils that can prevent the migration of leachate to bedrock and groundwater.

— Treatment facilities must be located within reasonable transportation distance of the major waste generation areas.

— The site selection process must involve an assessment of environmental, engineering, economic and socio-economic factors, in great detail. The candidate site or sites will be submitted to a public hearing for approval by an independent panel.

The hydrogeologists Gartner Lee Associates Limited are currently collecting and analyzing all available hydrological and soil information in the province to determine what general areas fit our requirement for natural, predictable features.

As a result, we have no long or short list of candidate sites in mind at this time. Nor are we simply adopting the short list of sites contained in a report done for Ontario in 1980.

One particularly sensitive issue concerns the use of prime agricultural land for a landfill. The requirement for a secure landfill location happens to correspond to the characteristics of some Class 1 and Class 2 farmland. While we cannot, therefore, automatically rule out prime agricultural land, we can make one promise: if two sites are found to be equally suitable, one on agricultural and the other on non-agricultural land, the non-agricultural site will be chosen.

The OWMC is committed to involving the public as it moves through each stage of the facility development process, and it will provide funds for participants and organizations requiring financial assistance in the public hearings themselves.

The selection process will be an open one. All sides will be able to benefit from shared information, and concerned citizens and organized groups will have an opportunity to express their views before decisions are made.

This does not mean that the OWMC has found a way to be welcomed with open arms into the communities it will approach. There will be some opposition, but we must ensure that the public knows it is coming, and has an opportunity to participate in the process.

At this time, the OWMC is meeting with groups throughout the province to discuss ways in which they can remain involved. At the first seminar of this type, held in Niagara-on-the-Lake, 23 groups were represented from industry, environmental and professional organizations across the province. Similar seminars are being held in other communities.

A newsletter is bringing the public up-to-date on our activities and their results. A series of workshops and seminars on industrial waste management will be sponsored and organized by the Association of Municipalities of Ontario. This will provide an important forum at this early stage of our work for townships, municipalities and local organizations to become involved in our work.

All of these efforts serve a central purpose: citizens must never again be caught by surprise on the subject of industrial waste. We have placed this as our top priority. OWMC must ensure that it is consulting with concerned groups and individuals each step of the way. If we are to find solutions to an urgent environmental problem, we simply cannot afford to do otherwise.

**Ministry of the Environment**

Ontario

Hon. Keith C. Norton, Q.C.,
Minister

Gérard J. M. Raymond
Deputy Minister

# *A decade of service*



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